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Cover:
Photographer John M. Dibbs (The Plane Picture Company) gets us so close to Rudy Frasca's P-40E you can almost hear it roar. Move over, Mustang!

AIR & SPACE

Smithsonian

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Volume 15 • Number 4

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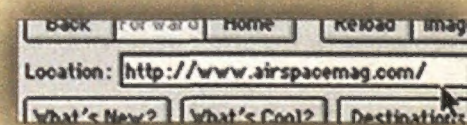
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Showtime for the Shuttle

We are approaching a couple of very significant milestones as the shuttle comes of age in more ways than one. In October of this year the shuttle will fly its 100th mission (commemorated in this issue by a poster and special section) to lay the keel for the International Space Station (ISS). In April 2001, we'll mark the 20th year of shuttle operations.

With the construction of the space station, the shuttle, that incredible though often maligned machine, is entering the most rigorous phase of its service life. The flight rate, the payloads, and the extravehicular activities in support of an anticipated 15 years of continual crewed operations will exceed anything that has ever been done before.

Maybe we should paint the word "experimental" on these spacecraft, because a shuttle flight is anything but routine. Over a million parts and systems have to be operating correctly for a launch. The weather at the abort landing sites has to be good, the crosswinds within limits. To make things even more difficult, everything must come together within a five-minute launch window for rendezvous with the ISS. Whether this could even be done was a major concern during the planning for the station. The NASA team has consistently demonstrated this capability in its recent launches. The amazing power and complexity of the launch can be controlled only by an exceptional team of professionals working in perfect harmony, with a keen sense of responsibility and total awareness of their surroundings.

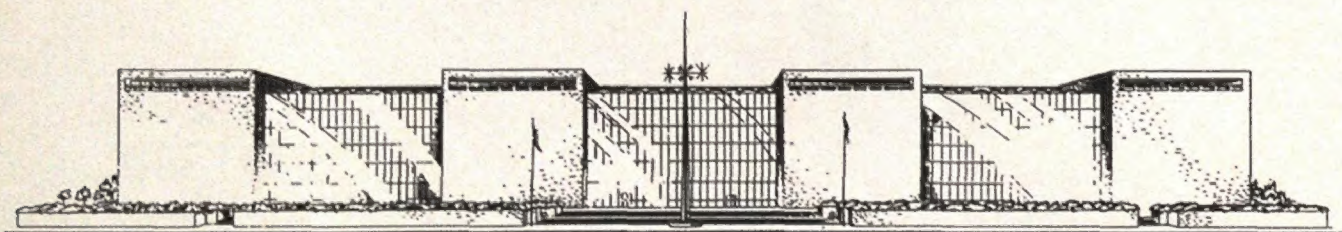
That NASA can make all this appear so routine is a credit to its ability, but the

accomplishment has also caused the world to take shuttle operations for granted. I have observed in amazement as people stopped watching a launch on TV even before the main engines have shut down because it was "no big deal." It is a *monster* deal! Just one blade of the turbo fuel pump generates about 450 horsepower, and the same pump could empty a family-size swimming pool in eight seconds. In addition, the pumps operate at temperature extremes that would either shatter or melt most mechanical devices.

If you have not seen a shuttle launch in person, you cannot appreciate its awesome power or fathom the incredible technical achievement it represents. As associate deputy administrator of NASA, I had the opportunity to observe our shuttle operation from relatively close quarters. To meet the people who make it happen was one of the greatest experiences of my life. After all, we are talking about human spaceflight: the engineers' ability to build and operate a system that can carry humans safely beyond Earth's atmosphere; the people who have the courage to fly and operate in these regions; the characteristics that have made this nation a leader in the realm of flight for the first hundred years and will continue to keep us there for the second.

Let's celebrate these milestones by tuning in and showing our appreciation for those who make it happen. It is showtime for the shuttle, and I am going to be glued to my TV set watching history unfold.

—J. R. Dailey is the director of the National Air and Space Museum.



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LETTERS

Risky Business

For all of us who worked on the F-20 program, it was a big disappointment when it was shut down ("The Airplane Nobody Wanted," Aug./Sept. 2000). Shortly afterward, an ad appeared in the aviation monthly *Pacific Flyer* that said what a lot of us felt:

"High-performance jet fighter, fully armed with missiles, guns, ECM equipment, fresh paint (stars and bars painted over), single seat, 97% reliability rate, will outclimb, outturn F-16, outrun F-14, low fuel burn (relatively), all digital avionics, radar, terrain following, INS, GPS, Tacan, used only for testing and sales promotion. Now in storage. Contact Northrop Corp. Will trade for MiG-25 and home address of Air Force Acquisition officer."

—William Church
Whittier, California

I was one of only three Navy pilots to fly the F-20. Of the 103 aircraft types I have flown, I can say without reservation that the Tigershark was one of the finest in terms of ease of operation, flying qualities, and performance. I couldn't agree more with General Welch, who said that "the Tigershark best suited the needs of developing countries." I don't recall the fate of the J-79-powered F-16, but in my view, buying it instead of the F-20 or the F-16A/C was a big mistake in terms of overall performance for the dollar. Logistical support of the F-16 relative to the F-20 was another key issue that was perceived totally incorrectly by potential buyers.

—Rear Admiral J.R. "Smoke" Wilson
U.S. Navy (ret.)
Encinitas, California

While I admire the corporate dedication that went into the development of the F-20, the observation that Northrop's other government contracts "more than covered the cost of developing the F-20" affirms my fears about government oversight and improbable project budgets. I only wish that my business could absorb \$1.2 billion in a failed development at the expense of one of my primary customers.

—Paul W. Hale
Doylestown, Pennsylvania

60 From All Sides

"60 and Out" (Aug./Sept. 2000) mentions the Professional Pilots Federation (PPF) petition for exemption to the mandatory-

retirement rule. As expected, in a letter dated July 3, the Federal Aviation Administration rejected our petition. Now we must turn to the Federal Appeals Court. The 7th District has already been notified and our filing is being drawn up. Two bills are in Congress now—S-1855 and H-4352—seeking to raise the "unemployment" age of pilots to 65. Both have received support because of the current and projected pilot shortage.

These bills and most of your article address raising the age and the ensuing problems. However, if the FAA grants exemptions, as the PPF has requested, those problems are eliminated. Contracts remain the same; medicals remain the same; the age-60 rule remains the same; only those requesting exemptions would be considered after taking stringent medical and psychological examinations.

By the way, most airlines cap out seniority raises at 12 years. Therefore, a retiring \$200,000-per-year captain would most likely be replaced by a \$200,000-per-year captain. Each person moving up would need training at great cost to the airlines. One 1992 study showed savings (deferred) to a major airline of \$53 million per year in training costs alone for each year the age-60 rule was raised. Exemptions are the way to go.

—Bert Yetman
President, Professional Pilots Federation
Grapevine, Texas

As a younger pilot for a major airline, I always find it interesting to read articles about the age-60 rule. Every pilot that gets hired today knows the harsh reality of the rule and is quite happy about it. The truth is that the pilots who are questioning the rule have used it to their advantage for their whole careers and have never complained. These guys finally have seniority—because of the age-60 rule—and now they want the rules to change to their advantage. If the person questioning the rule is a 35-year-old airline pilot, maybe I'll listen.

—John White
New York, New York

"60 and Out" makes reference to becoming a "freight dog, flying unscheduled transports late at night, since the Federal Aviation Administration doesn't care as much about the safety of a load of car bumpers as it does about a cabin of warm bodies." I wholeheartedly agree with the second half of the statement, but as a freight dog who flies transports (DC-8s) late at night, I must take issue with the first half. We

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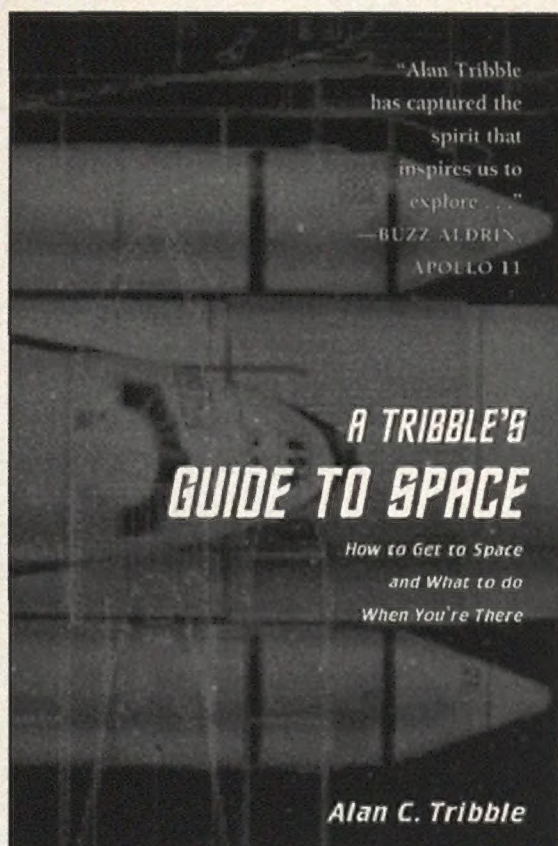
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operate under the same Part 121 of the Federal Aviation Regulations as other pilots, and we are subject to the same mandatory retirement issues as pilots from passenger carriers.

—Robert Phoenix

Captain, Emery Worldwide Airlines
Bedford, Texas

The FAA imposes age restrictions on non-pilot employees too. From a 1976 Civil Service Commission announcement of air traffic control employment opportunities (still in effect): "On the basis of extensive studies and experience, it was determined that those unique skills and abilities necessary for control of air traffic begin to decline at a relatively early age. As a result, a maximum age limit of 30 at the time of appointment for all candidates has been established for Air Traffic Controller positions at towers and centers in the FAA."

Additionally, U.S.C. 5, Section 8335 states that controllers "shall be separated from the service on the last day of the month in which the individual becomes 56 years of age. On a case-by-case basis the Secretary of Transportation may exempt a controller who has exceptional skills and experience from mandatory separation until the controller becomes 61."

To the best of my knowledge, such an exemption has never been granted.

—D.P. MacLeod
Salem, Virginia

Stephan Wilkinson got it partially right. But he missed the mark totally in a couple of key areas. Airline bean counters would almost certainly benefit from a relaxation of the age-60 rule. The biggest savings would be in post-retirement costs. All of the major airlines would save millions of dollars annually by recapturing a couple more years of pilot productivity, and benefit from fewer years of issuing those six-figure retirement checks.

—Michael Ward
Deer Harbor, Washington

I think we need a "50 and out" law for aviation writers like Mr. Wilkinson. I take great exception to his article, and, in particular, his last-line reference to the 63-year-old captain. The accident report could very well read, "Despite his many years of experience, the captain was unable to save the airplane and its precious cargo."

—William L. Bow (age 48)
DC-8 Captain, United Parcel Service
Clermont, Florida



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A Primer on Paint

The Western Pacific 737s and the Continental 777 millennium paint jobs were done here at the B.F. Goodrich Aerospace Airframe Services Division, located at Paine Field in Everett, Washington, using a combination of computer-generated tiles and hand painting. My personal favorite was "The Simpsons." When it rolled out of the paint hangar there was a hushed, almost reverent reaction by those who saw it for the first time. It soon got the nickname "electric banana" here.

The Sam's Town aircraft had a rather embarrassing side to it: At the base of the vertical fin is a small, triangular panel, right about where the young lady's bottom is touching the fuselage. This requires accessing during maintenance.

Another problem: Even though people identified with the Simpsons or the ProRodeo Hall of Fame aircraft, nine out of ten people could not identify what airline the craft operated for!

—William R. Downing Jr.
Everett, Washington

Making a Splash

As a former shuttle astronaut, I was intrigued by a couple of details about the recovery of Gus Grissom's lost Mercury capsule ("Deep-Sea Fishing," Above & Beyond, June/July 2000). I can't believe engineers or astronauts would have allowed the placement of HBX explosives on a manned spacecraft just so a lost capsule could be located if it sunk. What about a malfunction causing a detonation (and death) during flight? And why explosives? What about an active "pinger"? And how would one detonation have identified the location? And why the 4,000-foot figure? Didn't NASA care if the capsule sank in 3,000 feet of water? And how many other manned missions flew with this system? Can you enlighten your readers?

—Mike Mullane
Albuquerque, New Mexico

Curt Newport replies: NASA placed not just one but two HBX explosive devices on Liberty Bell 7, one jettisoned at main parachute deployment to mark the capsule's landing point and the other for marking the location of the capsule if it sank. I suspect that they had another purpose: Blow the thing to bits so the Soviets could not find it.

Given the fact that Grissom's launch vehicle and spacecraft already had generous amounts of liquid oxygen,

alcohol, high-strength hydrogen peroxide, and other flammable material, having the HBX probably did not make the flight much more hazardous. The bombs could be actuated only by water pressure and were mechanical devices. Regarding the use of an active pinger, I do not think that in 1961 they had such devices in a small enough size to easily mount to a manned capsule. Even with only one detonation, NASA could identify the impact point by triangulating on the location using the SOFAR listening network.

Regarding the 4,000-foot detonation depth: This was critical for the SOFAR network to detect the explosions. In the ocean, there is an area in the water column where thermoclines act like a rough wave guide, allowing acoustic energy to bounce between the layers for a long distance. This was called the "SOFAR channel" and allowed the explosions to be detected from as far away as 3,000 miles—hence the depth requirement.

Legends Everywhere

As I was reading about Ted Williams in "A Legend Drops In" (Letters, Aug./Sept. 2000) I remembered a passage I had recently read in *John Glenn: A Memoir* about Glenn flying with Williams when the latter belly-landed his plane. If only Robert Veazey had known then that two legends were in his presence.

—Michael S. Gerhart
Ulster Park, New York

Correction

Aug./Sept. 2000 "First Up": The caption on page 73 misidentified X-15 test pilot Joe Walker as Bob Walker.

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Into the Breach

Clearly visible from 70 miles away, the smoke and heat from the wildfires north of the resort town of McCall, Idaho, raise a 40-mile string of cumulus clouds to 35,000 feet, a scene repeated at the sites of a hundred major wildfires in the western half of the nation last August. Some 300 helicopters operated by private contractors and the Army are making water and retardant drops, shuttling firefighters, hauling cargo, and performing medevacs and reconnaissance.

The battle against the 63,000-plus-acre Burgdorf Junction fire, in the 2.3-million-acre Payette National Forest, is typical of the dozens of wildfire suppression efforts that are using air attack. Features of terrain and variation in fuel density—the thickness and dryness of the ground cover and timber—are unique to each fire. Firefighters on the ground try to slow the advance by clearing a six-foot swath of brush and trees around the

edge of a blaze, creating “fire breaks” that rob fires of fuel.

Last July 14, the U.S. Forest Service declared the Burgdorf fires a “Type One incident,” making a control effort a priority. Within 24 hours several camps that would provide for hundreds of firefighters were assembled in alpine meadows near the fire’s origin, along with two heliports, a helicopter base camp with an air traffic control center, and two helicopter refueling stations.

A variety of helicopters are fighting the Burgdorf fires. A Bell L-3, 205, 206B, 212, and Aerospatiale Lama refuel at the base camp. The heavy helicopters—a Sikorsky S-61, an S-63, and a Skycrane—refuel at a separate base they share with four Army Blackhawks from Texas.

Leroy Brown of Idaho Helicopters, a past president of the Helicopter Association International, which had put out a call to arms to civilian members with firefighting equipment, climbs out

In the hot zone: (clockwise, from top) Soldiers arrive in a Blackhawk, Marine One brings President Clinton to observe the damage, and a Bell totes a Bambi Bucket.

of a 205B. A waft of wood smoke spills out of the cockpit. “That’s the smell of money,” Brown says. “We’ll be here until the snow flies in October.” Fire experts agree that these fires will blaze until rain or snow extinguishes them.

Brown makes 250-gallon water drops with a Bambi Bucket (named for the Disney deer who lost its mother in a forest fire) that he refills in alpine lakes. He works in the smoke on virtually every drop. “You have to get in and out quickly or you’ll just fan the flames,” he says. In the dense fuels of the Payette Forest, one Bambi Bucket will soak 30 feet of fire line. Brown gets called in when flames threaten to breach an established fire line or winds shift, threatening firefighters on

the steep terrain. He makes as many as 100 water or retardant drops in six hours' flying time, a hazardous job that had killed two helicopter pilots during the early 2000 fire season.

The Burgdorf fire suppression effort costs roughly \$400,000 per day. President Clinton visited the fire to announce the release of \$150 million in emergency funds for fire suppression efforts. The assistance that the Army Blackhawks provide isn't tallied into the bills as are the invoices of private contractors. The Army must avoid doing work that the civilian contractors could provide. "We're mostly doing extractions of injured firefighters, some cargo handling, and troop movements," Blackhawk pilot Mark Montague says. "Communications are critical. Coming here for the Army is like being a National League team in an American League stadium. There were differences in terminology and procedures, even hand signals. We're still learning to adapt ourselves to assist in any way we're asked."

Mike Bobo, a helicopter refueling supervisor, has some misgivings about the usefulness of the Blackhawks. "They blow dead trees down, fan flames, and can really raise hell with the firefighters on the ground with the huge amount of rotor wash they throw down," he says. "These Army pilots are under orders and just go in and do what they're told. A civilian pilot can look at a situation where the helicopter can do more harm than good and just refuse to go in."

Bobo's pilots, however, are allowed to fly for only 36 hours in any six-day period. When their time is up, the Army pilots take up critical roles like transporting both Army and "hotshot" crews, the frontline firefighters. There are no supernumeraries on a wildfire the size of Burgdorf, but coordinating military and civilian crews on the first fire here to get a military contingent can be daunting.

Acting as a mini Airborne Warning and Control System, a twin-engine Aero Commander orbits the fires, coordinating aerial suppression and support from 1,000 feet above the traffic. (By mid-August, the Montana fires had created so many air traffic and communication demands that the National Guard requested a bona fide Air Force E-3 AWACS). On board, an air attack supervisor—an ex-hotshot—helps prioritize the requests for support from ground crews. The copilot runs five or six radios at a time, mentally filtering out non-essential transmissions and triggering on aircraft ID numbers. Up to two dozen aircraft work over a few square miles. "This can be real stressful," copilot Russ Gripp says, pausing to key a microphone.

"These incidents can also bring out some very focused and attentive behavior. I love this work," he adds.

Pilot John Roskos of Aero Commander Northwest of Wenatchee, Washington, flies around a 100-square-mile towering cumulus that is capped at 32,000 feet with its own lenticular clouds, which usually form in mountain waves. It is sublime up here, eerily wonderful, with the burnt ocher sun setting and one last helicopter below making a twilight water drop while two C-130 tankers from another fire fly over us, headed back to La Grange, Oregon. After a day of turbulence, the air has finally become buttery and a nearly full moon rises along the flank of the magenta smoke column. On the timbered ridges below, the downslope evening winds spill fire into unburned valleys.

—Tom Harpole

The Pre-Owned Fighter Market

Let's say you want to buy an American-made F/A-18 Hornet or an F-16 Fighting Falcon. You'd have to be a friendly foreign government and get Congressional approval for the purchase, right? Attention K-Mart shoppers: For a limited time, a Wichita, Kansas company has for sale just two such jets. But hurry; it could be the last time these breeds of frontline fighters are on the U.S. commercial market, if the Pentagon has anything to say about it.

"It's been a big pain in the Department of Defense's ass," explains Ken Bryant, president of Air Capital Warbirds, which deals exclusively in jet fighters, 1950s vintage on up. "They were really embarrassed. But they were satisfied that our paperwork was perfectly legal and they gave us a clean bill of health."

"They" are representatives of the Defense Reutilization

Marketing Office, which disposes of U.S. military surplus on the open market. Once word of the jets' availability got to Washington, the reps paid Bryant a visit. "We went down to Wichita to see if the fighter he had in possession was allowed," says Matt Brown of the DRMO. "We're still looking into it, but my official comment would be 'No comment.'"

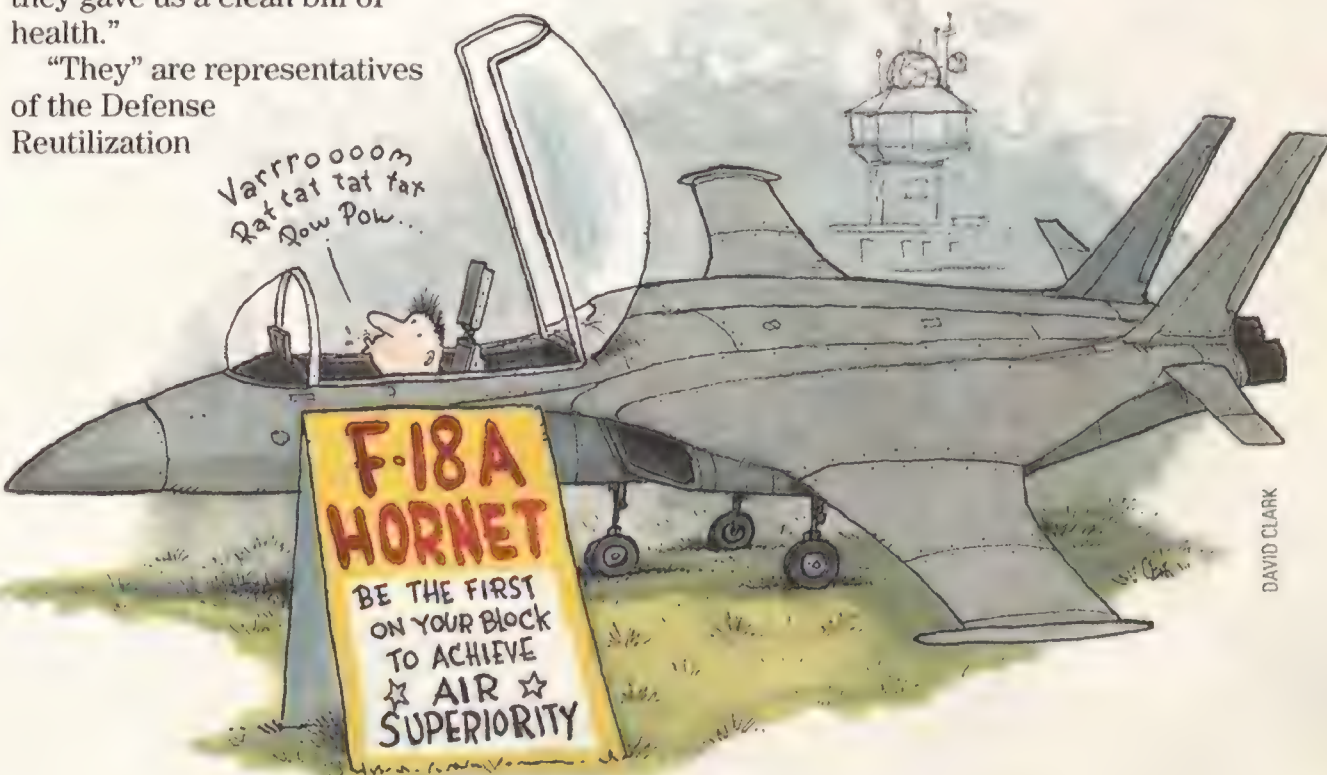
Bryant maintains he bought both fighters fair and square after they were officially pronounced scrapped. The F/A-18 he trucked in from Robbins Air Force Base in Georgia; beneath its flat gray paint lies a coat of glossy navy blue and a Blue Angels insignia. The F-16 arrived third-hand from Idaho, and Bryant can't even guess where it was before that.

Though he refuses to tell what he paid for them ("Maybe I paid too much"), once he returns the F/A-18 to flying condition, it could go for between \$15 and \$17 million, while he expects the F-16 to bring in \$12 to \$14 million. "The difference? You got one less one-million-dollar engine," Bryant says.

Who would buy such a beast? "We have a clientele of the—let's call it the upper income bracket—who have an airplane that may not perform as well as this one will and they kind of want to upgrade," Bryant says. As for the jets' operating costs, "I don't have a clue—very expensive." And they're destined to remain rare specimens.

"They're guaranteed to be the last two," he says, "after [the DRMO] came down to look at everything so they can 'improve' the way they sell their junk, or what they deem to be junk." But Bryant still retains the legal right to sell some prime samples of that junk, which he'll gladly do when the first U.S. citizen ponies up the asking price.

—Phil Scott



One Giant Leap for Space Tourism

In the high-price world of adventure travel, it's not unusual to spend thousands of dollars trekking to remote corners of the globe. But nothing comes close to the trip California businessman Dennis Tito is planning.

The 59-year-old investment wizard, who once plotted paths for the Mariner space probes, is going to Mir. Tito, the co-founder of pension fund advisor Wilshire Associates, will become the first full-fledged tourist in space.

"I had this dream over 40 years ago, and at that time I didn't have a penny to my name," said Tito during a press conference in Russia, where he was undergoing an initial battery of medical and psychological evaluations for the flight. Tito will spend roughly one-tenth of his estimated \$200 million fortune for the nine- to 10-day expedition, tentatively scheduled for 2001. He plans to take pictures and perhaps participate in research experiments. His chief concern, however, is that he not be a burden on the cosmonauts who will transport him to and from the station and maintain the outpost during his stay.

In the 1960s, Tito worked at NASA's Jet Propulsion Laboratory in California, devising ways to fly spacecraft to Venus and Mars. Increasingly intrigued by the financial world, he left NASA in the early 1970s to develop a scientific approach to money management, a strategy that has made Wilshire Associates one of the country's most lucrative financial management firms.

But Tito says the desire to fly in space has been on his mind for a long time. "We have one life to live on the Earth, and my commitment to myself is to fulfill all of my dreams that are healthy and legitimate," he says. "I am optimistic that I do have the right stuff to make this flight."

Today, the right stuff for Mir seems to be cash. MirCorp, a private firm that has exclusive rights to market the Russian space base, is banking on a mission by Tito to open the doors for a robust commercial space business, including satellite assembly and deployment services as well as tourism and entertainment. Company officials say they plan to replace Mir's aging core module and expand the outpost. Russia had planned to remove Mir from orbit last year, but then decided to support operator RSA Energia's efforts to privatize the laboratory if outside financial support came through. Energia

is the prime investor in MirCorp, which has raised about \$100 million in private investment.

Two previous attempts to fly tourists to Mir have fallen through. British businessman Peter Llewellyn got as far as a few days of cosmonaut training before it became apparent the financing for his trip was not in place. Likewise, Russian actor Vladimir Steklov, who was to film scenes for a movie on Mir, was cut from the last crew when producers failed to pay for his ticket. With Tito paying his own way, MirCorp officials are confident the former Russian space station will soon be hosting its first so-called Citizen Explorer. And with buzz about a trip to Mir for the winner of another reality TV show, perhaps he'll be followed by the first Citizen Survivor.

—Irene Brown

Bumper Crop

Of all the rockets launched from Florida's Cape Canaveral in the past 50 years, none is as significant as the first: Bumper. Sent aloft July 24, 1950, little Bumper 8 was the world's first two-stage rocket—a German V-2 missile topped with a U.S. Army WAC Corporal—and though a structural failure caused it to break up at 50,000 feet, Bumper 8 demonstrated a critical principle of spaceflight: The final velocity of a rocket equals the sum of

the velocity of each of its stages.

Last July, half a century later, a dozen project veterans, including a designer of the V-2, gathered at the Cape to remember their accomplishments. "Bumper was really the beginning of the space program in the United States," retired Major General Jimmy Morrell, chairman of the Air Force Space and Missile Museum Foundation, reminded the group—many of them pushing 90—who had brought their families to the ceremony at the site where it all began.

A darkened patch of concrete where the rocket sat and the ruins of a blockhouse a few hundred yards away are about all that's left of Project Bumper at Space Launch Complex 3/4. A kiosk tells the story of the twin pads, built at a cost of \$683,167 each. Pad 3 was finished only 45 days before Bumper 8 was launched. Workers serviced the rocket from 55-foot-tall rolling painters' scaffolds. The blockhouse wasn't finished, so a tarpaper shack was used.

Adolf Hitler gave the V-2 program the highest military priority. But Konrad Dannenberg, one of the Peenemünde missile scientists recruited by the Pentagon's Project Paperclip in 1945 to come work in the United States, claimed Wernher von Braun's team had a peaceful and profitable purpose in mind. "We've got small islands in the

The launch of Bumper 8 in 1950 inaugurated the U.S. space program.



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north of Germany and on a bad day the mailmen couldn't deliver the mail," he recalled. "So we thought, why don't you use rockets?" Of course, von Braun wanted to build big rockets for a trip to Mars. "But we realized that for that you'd need a huge rocket," said Dannenberg, "probably even a complete fleet of rockets to get there, and we wanted to make smaller steps."

Bumper 8 wasn't the first. Six went before it, all launched from the Army's White Sands Proving Ground in New Mexico in 1948 and 1949. Five of the eight were failures. But the last, Bumper 7, launched five days after Bumper 8 broke up, arced 48,000 feet over the Atlantic Ocean and attained Mach 9, the highest sustained speed in Earth's atmosphere at the time.

Two incidents elicit nervous laughter from Bumper veterans to this day. There was the rocket that landed in Mexico. "It wasn't a Bumper. It was a V-2, all right, that landed in the cemetery in Juarez," said Bob Droz. As a Jet Propulsion Laboratory employee, Droz tested and fueled the WAC. But he was there when the V-2 crashed. "There was a lot of apologizing and we were sorry we did that." Then there was No. 5, the Bumper that set the era's altitude record: 248 miles. Its wreckage went missing for a year. "I don't recall that it landed actually in Mexico, but nobody looked for it because it was going to cause an international incident at the time," said Herman Bank, the Jet Propulsion Laboratory project engineer in charge of Bumper design and development. "Afterwards, we did find that some

farmer—as I recall, he was in southern New Mexico—found the debris in one of his cattle yards. They called us over to look at it and we were told that it might be diplomatic if we just made no issue of it."

"You got us out of the starting blocks," Brigadier General Donald Pettit, commander of the 45th Space Wing at the Cape, told the vets. "We're trying to continue your legacy." Roy Bridges, a former astronaut who is now the director of NASA's Kennedy Space Center, told the group: "I just want to say that it hasn't gotten any easier to conquer space since you left." The next day, a Russian-made living quarters module docked at the International Space Station—two years behind schedule.

—Beth Dickey

Salvage Yard Serendipity

Some of the most remarkable discoveries are also the least expected. Like Christopher Columbus stumbling onto the Americas, Steve Cannaby went to a salvage yard last year looking for aircraft radios and found instead an icon of the Jet Age: the first Boeing 707 flight simulator.

Cannaby, president of an aircraft instrument repair company near Wichita, needed a radio stack for a convention display. "No, we don't have radios," he was told at the yard, "but we've got a whole cockpit." He was amazed to find a nearly complete simulator, parked amid old furnaces and boilers. Though it was protected only by tarps, the huge device was remarkably free from corrosion and



Boeing's first 707 simulator needs a good home.

rodent damage.

Cannaby was smitten. He and two friends bought the simulator for \$10,000. On moving day, they arrived with a truck large enough to transport their five-ton purchase. Yard workers then casually mentioned that some equipment and papers came with it. A second truck was needed to haul away seven file cabinets full of documents, along with spare parts and other hardware. After the move to Cannaby's hangar, a further surprise awaited the trio. Examination of the documents and a data plate on the unit told them they were now the owners of "Boeing 707 Simulator, Serial Number 0001."

The simulator has a full cockpit, with scissor-action stilts and a hydraulic power pack for motion. Also included are the instructor's console and more than a ton of cable. After some refurbishing, says Cannaby proudly, "it looks like a jewel. It's kind of like finding the Mona Lisa at a garage sale." He and his partners cleaned, rewired, and reconnected the cockpit instruments so they light up again. The throttle quadrant was missing, but using part numbers from the manuals, the team was able to track down a replacement. Still missing, though, are the 707 medallions from the yokes. There's no simulated-view equipment for the cockpit window, and much of the computer hardware is gone.

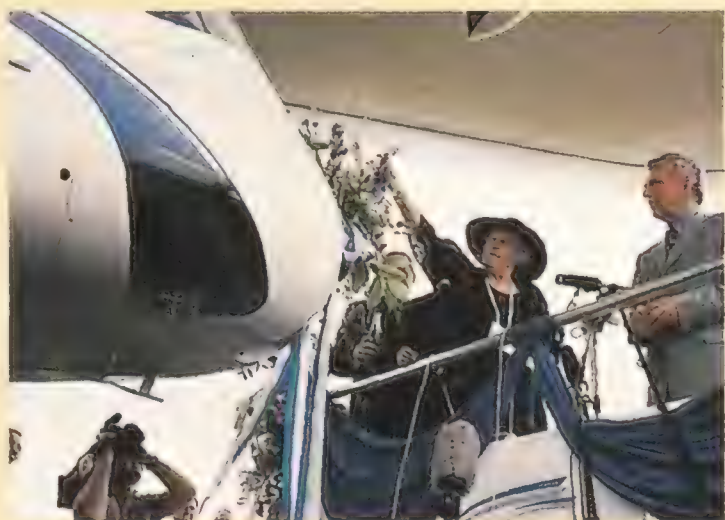
Even with all the files that came with it, much of the simulator's history remains undocumented, and Boeing hasn't been able to fill in the gaps. Cannaby has learned that Link built it, but beyond that, the paper trail begins only around 1967, when Boeing accepted it from Link. Boeing used it to train line pilots and then as an engineering simulator for designing new cockpits. The simulator eventually went from the Boeing plant in Renton, Washington, to the one in Wichita, and then, probably around 1993, it was consigned to the scrapyard.

Cannaby would like the next stop to be a museum. He's had discussions with

UPDATE

We Have Liftoff

Christened with champagne by Elisabeth Veil, granddaughter of Count Ferdinand Graf von Zeppelin, and accompanied by Friedrichshafen mayor Bernd Wiedmann, the Zeppelin NT *Friedrichshafen* lifted off and flew over Germany's Lake Constance last July 2, precisely 100 years after the maiden flight of Luftschiff Zeppelin Number 1. The *Friedrichshafen* is the first of a new breed of advanced semi-rigid airships ("Company Town," Feb./Mar. 1997) that will begin carrying sightseers through the Alps next May. Suspended inside the Zeppelin company hangar was the envelope of a second airship, destined for Skyship Cruise of Switzerland. With the flight test program almost over and certification expected by year's end, production is well under way on five contracted airships.



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several, including the National Air and Space Museum. Robert van der Linden, curator of air transportation, says, "It sounds like a wonderful artifact to collect, but many things would have to be figured out first"—including the simulator's condition, how it would be transported, and whether there's a place for it.

NASM's new Steven F. Udvar-Hazy Center at Dulles airport in Virginia will house Boeing's Dash 80, prototype of the 707. A logical place for the simulator might be alongside Dash 80, say both Cannaby and van der Linden. It would show visitors what the 707 cockpit is like, and it could serve as a tribute to Tex Johnston, the Boeing pilot who first flew Dash 80 and led development of the 707 training program. In addition, the simulator has historic significance of its own: It is one of the earliest training devices built for the burgeoning jet airline industry.

Cannaby is also exploring interim uses for the simulator. One possibility is a traveling exhibit, complete with audio and video presentations. He says the show could include a re-creation of Tex Johnston's famous demonstration of the Dash 80's solid construction: In 1955 he twice barrel-rolled the four-engine jet over Seattle's Lake Washington for an audience of airline executives.

—Lester A. Reingold

Wichita's Dog Days

It's an unlikely warbird. Slow. Toothless. Homely. Yet the L-19 (later designated the O-1) Bird Dog, the little two-place liaison/observation tail-dragger that distinguished itself in Korea and Vietnam, inspires devotion among pilots who flew it in combat, pilots who fly it now, and its surviving creators. Some 200 of these admirers and 44 L-19s descended on Wichita last July to celebrate the Bird Dog's 50th birthday in its hometown.

"We have 25 percent of the flyable aircraft here," said Minard Thompson Jr. of the rows of L-19s in military markings on the ramp outside the Kansas Aviation Museum. "Fifty percent of Bird Dogs work for a living, so we have half of the pleasure aircraft, which is a pretty darned good turnout."

Thompson, author of *The Lovable One-Niner*, the definitive guide to Bird Dogs, organized the three-day anniversary reunion in conjunction with the International Bird Dog Association. Retired Cessna employees who designed and built the Bird Dog joined former military pilots and current owners gathered around the airplanes, defying the near hundred-degree heat.

"We outfoxed Old Man Piper," engineer



Don Simon chuckled, recounting the aircraft's genesis. In 1949, Cessna learned that the Army, seeking new liaison aircraft, was considering buying off-the-shelf Pipers. Cessna designed and built the L-19 in nine weeks, using wings from a Model 170 and the tail from a 195. The company won the contract, eventually building almost 3,400 Bird Dogs.

"I had my fingers on all these L-19s when they went down the assembly line," said Ray Myers, the assembly superintendent. "I had the most efficient assembly line in the United States. We'd build an airplane every 20 minutes." Jack Swayze, the former electrician crew chief who came up with the winning entry in the contest to name the aircraft, recalled how the nickname came to him. "I just looked at it and it looked like a dog with ears hanging out," he shrugged.

First used in Korea, the Bird Dog achieved its greatest glory in Vietnam, where it was flown by forward air controllers, who adjusted artillery fire, controlled air strikes, and coordinated rescue operations. "When somebody got in trouble, if you could get a Bird Dog up there, your chances of survival just went up," said Jimmie Butler, who flew L-19s out of Thailand during the war. "Because the bad guys knew once the Bird Dogs showed up, the Bird Dogs were going to bring F-100s in on them, and F-4s."

Today, besides being flown privately, L-19s are flown commercially as spotter aircraft as well as banner and glider tugs, and are also used by the Civil Air Patrol. Several current owners first flew them in the military, forming a lifelong bond with the airplane. Minard Thompson Jr. was among them. His Bird Dog took the

Grand Champion Lindy Trophy for warbirds at the 1996 Experimental Aircraft Association fly-in in Oshkosh, Wisconsin, earning the L-19 a new

measure of respect in the warbird world.

Standing by an L-19 painted in Army colors, three former pilots from the 220th Reconnaissance Airplane Company, the Catkillers, reminisced about flying in Vietnam. "We used to troll for fire for fun, and you could usually find some," said Bob McComiskie of North Andover, Massachusetts. "You develop a bond like you never develop in any other situation," said Jerry DiGrezio of Hollis, New Hampshire, "and this airplane was the catalyst for that bond, so it's a very important part of our lives."

Though it remained anonymous throughout the war, the Bird Dog achieved its greatest notoriety on the conflict's final day, April 30, 1975, when South Vietnamese air force forward air controller Major Bung Ly, with his wife and five children in the back seat, landed an L-19 on the USS *Midway*, 75 miles out at sea, after the ship's captain ordered millions of dollars' worth of helicopters shoved overboard to clear the flight deck (see "Escape from Saigon," June/July 1998). Now living in Orlando, Ly received a hero's welcome at the reunion.

His memory of the landing: "My first feeling when I touched down on the deck, I say, 'Thank God that I'm all right, my family's alive.' I don't know nothing else but my family survived." The Bird Dog he flew now hangs in the U.S. Naval Aviation Museum in Pensacola, Florida.

—James Wynbrandt



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Mr. Estes Comes to Washington

Vern Estes is a quiet, soft-spoken man. Close to 70, he still has the all-American looks of a farmboy and a modest "Aw, shucks" personality. However, thanks to the work he did in the 1960s while the space race between the United States and the Soviet Union was unfolding, millions of model rockets have flown without a reported single fatality or serious injury. Through the company he founded in 1961, Estes Industries, a majority of these rockets have borne his name. Last May Estes came to the National Air and Space Museum to appraise the Museum's large collection of model rockets and recount for curators how the Space Age hobby got off the ground.

After the space era began with the 1957 launch of the Soviet satellite Sputnik, many a boy tried his hand at launching homebuilt rockets. In the book *The Rocket Boys*, the author, Homer Hickam, writes of his and his friends' attempts to launch rockets from fields near his home in West Virginia. Many of the materials needed for these experiments could be bought through ads in the back of hobbyist magazines. Because of their explosive nature, however, such materials are exceedingly dangerous.

Through his association with rocketry, Hickam eventually became a NASA engineer, but his story's happy ending has a darker side. The American Rocket Society estimated that as many as one in six amateur rocket experiments in the 1950s and '60s resulted in a fatality or serious injury. Because such unsafe experiments were being conducted by young people, the ARS referred to it as the "American Youth Rocketry Problem." Solving it was no easy matter, though. Simply loading match heads into a carbon dioxide cartridge can result in a device capable of launching a rocket hundreds of feet into the air. Just as easily, it could also produce a pipe bomb with deadly consequences. What was needed was a safe, commercial product that would allow inquisitive young people to safely experiment with rocketry.

The solution was devised by a shoe salesman named Orville Carlisle, who was



CAROLYN RUSSO

also an amateur inventor experienced in pyrotechnics. Carlisle devised the Rock-A-Chute, a rocket propelled by a small engine. At peak altitude, the engine fired a small explosive charge that pushed a parachute out of the rocket body. The Rock-A-Chute then returned slowly to the ground, where it could be fitted with another engine to fly again. To market his product, Carlisle approached science fiction writer G. Harry Stine. Together with several investors, Stine and Carlisle started Model Missiles, Incorporated in Denver, Colorado, in 1957.

The products sold by Model Missiles were beautifully designed and instantly popular. The demand was so great the company could not keep up with the orders. In particular, the rocket engines, built by a contractor, were slow to ship and extremely unreliable. Stine needed a new supplier, and the Estes family fireworks business was the first one listed in the 1959 Denver phone book.

When Stine called them, they pointed him to their young son Vern, who quickly envisioned the hardware necessary to produce a reliable model rocket engine. To save money, he scoured junkyards for parts, and in a short time he had completed "Mabel," a machine capable of manufacturing an engine every five and a half seconds. That was even faster than Model Missiles could sell them, so to unload the surplus, Estes and his family placed an add in *Mechanix Illustrated*. The response was overwhelming.

Several bad decisions later forced Model Missiles out of business, but the demand for model rockets did not go away. To fill the void, Estes began to design his own, beginning with the Astron Scout, which was small enough to fit into the mailing tubes he used to ship his model rocket engines. Estes sent the first Scout kit to his friend, G. Harry Stine, who quickly built and flew it.

After Model Missiles shut down, Stine

founded the National Association of Rocketry. Under his leadership, the NAR worked with state legislatures to improve rocket safety while promoting the value of commercial products such as Vern Estes'. Stine also saw the historical value of the culture of model rocketry. He collected everything he could, and in 1973 he donated dozens of boxes of model rocket material to the Smithsonian Institution, including original drawings, correspondence, catalogs, kits, and models. It took curators over 20 years to go through it all. With the passage of time and the death of Stine in 1997, the full significance of some items had been lost. Estes was the ideal person to help us at the Museum understand the history of some of these artifacts.

As the doors were removed from storage cabinets at the Museum's Paul E. Garber preservation facility, both the brightly colored rockets and the look on Estes' face lit up the room. There in front of him were artifacts he had not seen in years. One of the first rockets he identified was the original Astron Scout sent to Stine. It was not as well built as many of the other rockets, and it had obviously seen a number of flights. Still, it is the kit that launched Estes Industries 40 years ago.

"An original Astron Orbital Transport," Estes exclaimed as he picked up an unbuilt kit. "Two dollars and fifty cents. Sold!"

The Museum's collection also comprises model rocket artifacts from all over the world. "These Czechoslovakian engines never worked," said Estes. "They always blew up."

"So our German scientists were better than their German scientists?" someone joked.

Estes became particularly excited when he found the original Schutz-Estes Boost Glider, which he designed with a former employee. Marketed as the Astron Space Plane, it was the first device to successfully lift off as a rocket and return as an airplane, presaging NASA's space shuttle. In the same drawer were two Astron Space Planes, one in pieces. An accompanying note explained that these were prototypes. Evidently a test with a larger engine had caused the one to fall apart. Estes smiled and said, "That's my handwriting." At Stine's request, Estes had sent the rockets to his friend decades ago. The note was unsigned, and without Estes' help it would have remained a mystery to Museum staff. Thanks to Estes' visit, we now have a better appreciation of the importance of the Smithsonian's model rocket collection.

—Robert A. Craddock, a geologist at the Museum's Center for Earth and Planetary Studies, is writing a book on the history of American model rocketry.

A Golden Afternoon

On June 24, visitors to the National Air and Space Museum traveled back to aviation's Golden Age, the period between the world wars when flying evolved from a risky daredevil profession to a bankable business. While the U.S. Navy Band played vintage tunes such as "Stompin' at the Savoy" and "It Had to Be You," performers swing-danced in the Air Transportation gallery (below). Later in the afternoon, tentative tourists gave foxtrot lessons a try while family members egged them on, some seemingly more intent on humiliation than encouragement. The day's events included activities for all ages: Children listened to stories about flying, tried on flight jackets and pilot's hats, and tried their hand at airline logo design. Wielding fat Crayola markers, most of them sketched out crude pairs of wings and scrawled their names underneath.

In a more adult setting, visitors were treated to live re-creations of 1930s-era radio shows. At stage right, sound effects technicians shook pieces of sheet metal to simulate thunder (Hop Harrigan, our hero, is caught in the inevitable storm as he flies off in his B-26 to save a damsel in distress). After a brief commercial, in which listeners were assured that yes, these new-fangled oral laxatives do work, the show's narrator resumed, bringing the audience back to the days of barnstormers (so named because they flew through the open doors of barns). Later, visitors listened to stories of a time when flying by the seat of your pants meant that if you couldn't feel the seat, you were probably upside down.

—Daniel Weidinger

MUSEUM CALENDAR

October 12 G.E. Aviation Lecture. Chuck Yeager, who broke the sound barrier in 1947, returns for his annual lecture. Langley Theater, 7:30 p.m. Tickets will be available beginning September 18 through Tickets.com or by calling (800) 529-2440.

October 21 Join National Air and Space Museum staff astronomer Sean O'Brien for an evening of stargazing at Sky Meadows State Park in Virginia. For more information, call (540) 592-3556.

October 28 Monthly Sky Lecture. John Gribbin of the University of Sussex in England discusses how all of the chemical elements, except hydrogen and some helium, were created in the thermonuclear furnaces we call stars. Einstein Planetarium, 6 p.m.

Curator's Choice

Once a week, one of the Museum curators will give a 15-minute talk about a subject of interest. Oct. 3, "Von Braun-Disney Space Station Model"; Oct. 10, "Bell X-1"; Oct. 17, "Douglas DC-7"; Oct. 24, "Tupolev Tu-4"; Oct. 31, "New Views of Io and Europa."

Except where noted, no tickets or reservations are required. To find out more, call Smithsonian Information at (202) 357-2700; TTY (202) 357-1729.



HAROLD DORWIN

Our Brother Frank

"The toll collector was horrified. He had to wave us through the Holland Tunnel. It was rush hour and he didn't know what else to do. We had this old airplane wreck on the bed of my farm truck, and the drivers behind us were honking and backed up a mile. Yes, dear sister, they were slightly irate."

This is my brother, Foster, talking in his cannon boom of a voice. We are sitting on my California sundeck with the tape recorder at a safe distance. Foster is remembering a long-ago sweet time with our older brother, Frank Tallman, who collected old airplanes and was known as King of the Hollywood Stunt Pilots. In 1964, Frank established the Movieland Museum of the Air at Orange County Airport in Santa Ana, California, and, with fellow flier Paul Mantz, founded Tallmantz, an aviation company that did everything from assembling and flying fleets of vintage aircraft for movies to servicing police helicopters. My brothers were lifelong best friends, and mine too.

The New York rush hour episode developed after Frank had heard about an antique airplane languishing in a mid-Manhattan aviation trade school. "It turned out to be the Curtiss Gulf Hawk that had belonged to Al Williams, the famous exhibition pilot of the 1930s," Foster says. "It still had Williams' orange paint."

Frank was thrilled, and he called Foster at his farm in New Jersey for help. Foster drove his truck into the city and parked on the street below a sixth floor window of the trade school building. Lord knows how they got away with disrupting traffic.

"We had to go to a hardware store for wrenches and take the plane apart," says Foster, "but we still had a hell of a job pushing the damn fuselage out the window and lowering it. Of course it was raining. So there were Frank and I, trying to stay upright on this wet fire escape while fending off a half-ton missile with our bodies. We had to keep it from

smacking into the side of the building."

Foster put the Hawk in his barn with the cows until he found a furniture van to cart it west to Frank's hangar, then in Riverside, California. "I think Frank sacrificed an old Navy SNJ trainer for parts, which bothered him because he had fond memories of night flying in one over Corpus Christi during World War II. But the Hawk became a great airshow plane for Frank." In his book, *Flying the Old Planes*, Frank wrote that it was "doubtful...a lovelier-looking biplane ever flew."

One of my brothers' earliest foraging expeditions involved a Colonel Jarrett, who owned a war museum on Atlantic City's Steel Pier. "Jarrett was the expert on World War I everything," Foster says. "He had the world's biggest collection of World War I equipment, planes, cannons, tanks—the only guy I knew who could measure his collection by the ton. I remember the German aircraft machine gun in Frank's room that he traded in his teens to Jarrett."

Around 1950, after Jarrett had become curator at the Aberdeen Proving Ground Museum in Maryland, Foster and Frank went to see him to discuss the 1918 Sopwith F.1 Camel that Frank had seen at the Pier museum years earlier.

Frank had dreamed of owning a World War I airplane since hanging balsawood models from the ceiling of his boyhood bedroom. I remember the room's exotic aroma of airplane glue, but Foster remembers best the machine guns, and the Colt pistol with ivory grips that Frank had given him.

Jarrett had been forced to move his war relics away from the salty seaside air, and now the airplanes deteriorated in a shed near Aberdeen. Frank bought five with his Navy mustering-out pay. "The Camel, a Nieuport, a German Pfalz, and two real basket cases," Foster says. "Five planes for \$550—unbelievable."

They had to rent a stakebed truck and muscle the Sopwith Camel, Pfalz DXII, Nieuport 28C, and a Spad VII about 50

miles to a little grass airport in New Castle, Delaware. (A Fokker was just too heavy to move at that time.) The truck was followed the entire way, Foster says, "by a guy in a green Chevy, a washing machine salesman. Said it was the happiest day he ever had on the road."

Frank had the Camel and the Pfalz totally restored. "I believe Frank's was the only original Camel ever brought back to flying condition," says Foster. "Different people rebuilt it and took parts of other planes in trade as payment. Frank was a master trader. I remember he swapped his radio at boarding school for a Chinese bathrobe with a dragon on the back."

The Camel was Frank's favorite World War I airplane. "He was going to use it in the movies," Foster says, "but it was too valuable, except for publicity stunts. He made a copy of it with a modern engine for *The Great Waldo Pepper*."

In May 1956, when its restoration was complete, Frank flew the Camel at the Armed Forces Day airshow at Bolling Air Force Base in Washington, D.C. On the same weekend, the Company of Military Historians held its annual meeting at Annapolis. My brothers, being Fellows (Frank for airplanes, Foster for weapons), ran back and forth between the two events.

"Before the show," Foster says, "we had to park the Camel inside an 'alert hangar' where a jet fighter, maybe an F-94 Starfire, would park in those days. A pilot would sit in it and if he had to scramble, somebody could push a button and *whoop, whoop, whoop*, the whole front and back of the building would fly open, and he'd light the jet right in the building." Foster's decibels magnify the image.

"Anyway, I hit the panic button"—on purpose, he says—"and the alarms went off. There were maybe 100,000 people watching the show at that moment who had no idea what was happening. They must have figured: Here's an emergency and a jet's going to come roaring out of



Tallman's passion was collecting old airplanes and bringing basket cases back to life.

there." Instead, out came Foster pushing Frank in a Sopwith Camel across the ramp and onto the grass. "It had to take off and land on grass because it had no brakes—only a skid to drag it to a stop."

When whoever was supposed to spin the propeller didn't appear, Foster shouted up to Frank in the wicker basket seat, "Did Errol Flynn do it right in *Dawn Patrol*?" Yes he did. Both shouted "Switch off" and Foster grabbed the propeller. "You have to pull down hard a couple of times to feed fuel into the cylinders." Finally: "Contact" and "You're getting the hell out of the way or the prop will be back and chop you up." The engine fired, spraying castor oil on the lower wings, as it should.

"In the movies, where pilots shove the goggles up and the bottom part of their face is dark, well, that's castor oil. For an hour or two you have it hitting you in the mouth. My God, did they run for the latrine first chance they got. Brandy and milk were supposed to relieve the poor guys." Recalling the Historians' dinner at Annapolis, founder Duncan Campbell wrote that he sat between the Tallman brothers and that "Frank regaled us with

tales of the tricky man-eater," but that he "reeked of castor oil and declined eating."

"This was a Le Rhône rotary engine," Foster says, "and Frank loved the sight, sound, and smell of running rotaries, although this one was treacherous. It forced him into a lot of unplanned landings. But he once traded a Le Rhône for a very nice Rolls-Royce [sedan], black and gold, I think."

After the airshow, the Camel needed fuel. "Frank said the base would give him all the fuel he wanted, so they sent down a tractor-trailer. Must have held 40,000 gallons. This Air Force sergeant just stared at this little plane while I put in 18 gallons. He asked who was going to sign for the gas. I signed my ID—Captain, Infantry. The next line on this typical military form was for type of aircraft and number of gallons. The sergeant went away shaking his head."

One spring afternoon in the early 1970s, Frank flew his two-seat Curtiss TP-40N, a monoplane descendant of the Gulf Hawk, to New Jersey, landing at Monmouth airport, near Foster's home. The plane was painted in the Chinese

Nationalist markings, with the Flying Tigers' shark teeth on the nose. "I remember it was a beautiful day and Frank offered me and my sons a ride in this rare P-40." Foster let his sons go first. As son Baw, then a teenage football player with tree-trunk legs, told it, "The canopy was slid back and I'm sitting low with kind of a railing creasing my shoulder blades. Uncle Frank strapped me into a complete shoulder harness. I knew his controls were working in both cockpits when the stick in mine kept smacking me between my legs, but of course I wasn't going to say anything. The plane was roaring and you couldn't hear yourself think anyway. He put on his helmet and goggles and looked back at me and began a slow roll."

"Yes," Foster says, "and there was no time left for Daddy. That was the biggest gift I ever gave my sons."

One year, my brothers had a strategy for competing in the Miami-Nassau sailboat race in Foster's Columbia 40. "We got in Frank's Cessna 310 and flew the course the day before the race," Foster remembers. "The key in that race was to hit the Great Isaac Lighthouse and hang a right. Those were the days before LORAN. You're not sure what course to steer because you're not sure whether the Gulf Stream is driving you north. We went down to 50 feet to see where the Stream was running. You can tell by the color with all the weed in it."

That reconnaissance flight occurred only months after Frank had shattered his left kneecap and split the tibia when he fell off his son's go-cart in 1965. Infection set in, and the leg was amputated just above the knee.

"Frank was relaxed around us," Foster said. "On board, he felt no need to force himself to strap on the new leg. With a second-version leg and foot, he could control the artificial heel, even push it on a plane's brake pedal for a fast stop on the ground. About that time, in a hotel lobby in Texas, an ankle connection came apart. The foot, shoe and all, fell off, and a woman fainted dead away."

Though Frank's leg was not a problem on a long sail, he was known to take four Dramamines, even after Foster told him there would be bigger waves in his bathtub. Rolls and Immelmans never seemed to be a problem for Frank, and Foster considered this a wonderful irony.

In April 1978, while flying his Piper Aztec through a storm, Frank was in a fatal crash, just minutes from home. I remember Foster watching the TV coverage of our big brother's career. His face was expressionless, and it was the only time his booming voice was silent. But he had these, and a thousand other sweet times, to remember.

—Prudy Tallman Wood

The Lunar Module's Evil Twin

The two cosmonauts squinted out the window of the cramped Soyuz. They could just make out the spacecraft that ground control said was rapidly heading toward them. It was an awkwardly shaped vehicle with a mechanical arm menacingly outstretched...

It sounds like a scene from a sci-fi B movie, but in fact, at the height of the cold war, the U.S. military seriously considered developing a vehicle in which astronauts could inspect Soviet satellites up close and, if need be, destroy them.

It all began in November 1962, when NASA awarded the Grumman Aircraft Corporation of Bethpage, New York, the contract for the Project Apollo Lunar Excursion Module, or LEM. Grumman's largest contract, this was to be the first spacecraft ever built that would take human beings to another world.

After it won the contract, Grumman looked for ways to expand the LEM program. The company's Space Development Team began work on Covert Space Denial, a project to develop "a non-detectable action to incapacitate vehicles in space," in the words of a Grumman report. The team concluded that the LEM was well suited for the task.

All of the major systems necessary were already under development for the Apollo program. The LEM had a highly efficient, two-stage main propulsion system, combined with a fully redundant reaction control system and versatile guidance and navigation capabilities. All together, these technologies gave the LEM the capacity to change both the plane and the direction of its orbit—flexibility that a space vehicle would need if its crew had to fly off to inspect other craft. And the total maneuvering capacity of the LEM's engines could easily be enhanced with larger fuel tanks; as they were external to the vehicle, this was considered a simple modification. Grumman proposed a few other changes: the deletion of the four heavy landing legs, footpads, and shock absorbers (this LEM wouldn't be landing anywhere), plus the addition of a large mechanical arm,

which would have a variety of functions. Finally, though the original LEM had been designed to support astronauts for only several days, Grumman believed that relatively minor modifications—additional fuel cells, improved environmental controls, more water and oxygen—could enable a crew to live in the module for several months.

By the end of 1964, the project team produced a report entitled "Military Utilization of LEM in Earth Orbit." According to the report, if the U.S. military ever needed to get a close look at a satellite, it could deploy a LEM from a space station in polar orbit. This vehicle would contain photographic and other sensors that could tell if the satellite carried weapons.

The following May, the Department of State's U.S. Arms Control and Disarmament Agency contracted Grumman to conduct a study on an Arms Control Inspection System. Although it was a spacecraft, the Navy, not the Air Force, ran the program. The Navy awarded Grumman a contract to develop an Arms Control System based on its Lunar Excursion Module.

In response, Grumman proposed both an inspector version of the LEM and a hunter/killer vehicle. And what would the killer LEM be armed with? Laser cannon? Proton torpedoes? Would you believe...spray paint?

A company report reasoned: "[M]ost space vehicles, manned or unmanned, are vulnerable to unplanned variations in their operating environment. Temperature control is one of the most critical areas. Variations in surface properties can produce disastrous consequences." Through testing, Grumman had found that spraying black paint over 10 percent of the surface area of a spacecraft could raise the craft's temperature about 40 degrees Fahrenheit, causing equipment to fail. And painting



could serve another purpose.

The late Al Munier, a former Grumman engineer on the program, recalled: "I thought that the most effective thing, if you didn't like somebody else's satellite, was to get some black paint and spray their solar panels. They wouldn't know what happened. All of a sudden the thing would have no power."

Other proposed missions included using the LEM to capture, de-orbit, or disorient satellites (hence the mechanical arm), or depressurize the craft by pelting them with "synthetic meteorites."

Grumman also considered using the military module for attacks on manned spacecraft—for example, using lights or sounds to induce crew mental breakdown, or isolating the personnel by sabotaging their vehicle's communication antenna, perhaps by draping it with netting that would render it immobile.

In a surprisingly flippant style for a report prepared for the government, Grumman concluded: "[I]t is a snap to negate the usefulness of just about any satellite. As a matter of fact it appears to be a hell of a lot easier to upset a space vehicle than it is to protect it from interference by the enemy."

In 1967, the signing of the United Nations Treaty on the Peaceful Uses of Space brought various plans for space weapons to a halt, including Grumman's military LEM program. Had they known, scores of cosmonauts would have undoubtedly breathed easier.

—Joshua Stoff

"What can a retired pilot do?"



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CAPTAIN AND MRS. ELLIOTT

During a visit to the National Air and Space Museum, Captain and Mrs. Elliott stop in front of the B-29 in the Air Transportation Gallery.

Captain George William Elliott's romance with aviation spanned more than four wonderful decades. He began his career as a flight instructor in the cockpit of a Curtiss P-40. He trained to fly the Northrop P-61C Black Widow, and he retired as a United Airlines captain.

"I had to find a way to stay involved," says Captain Elliott. He and his wife, Virginia, discovered they could arrange a charitable gift annuity to benefit the National Air and Space Museum. "Our gift brought us such joy," adds Virginia Elliott. "George wanted to share his passion for aviation with others." They were so delighted that a year later the Elliots completed a second annuity.

To learn how a charitable gift annuity benefits you and the Museum, call 202-357-2493, or fill out and return the coupon below. You may also send an e-mail to gayle.union@nasm.si.edu. All inquiries are confidential.

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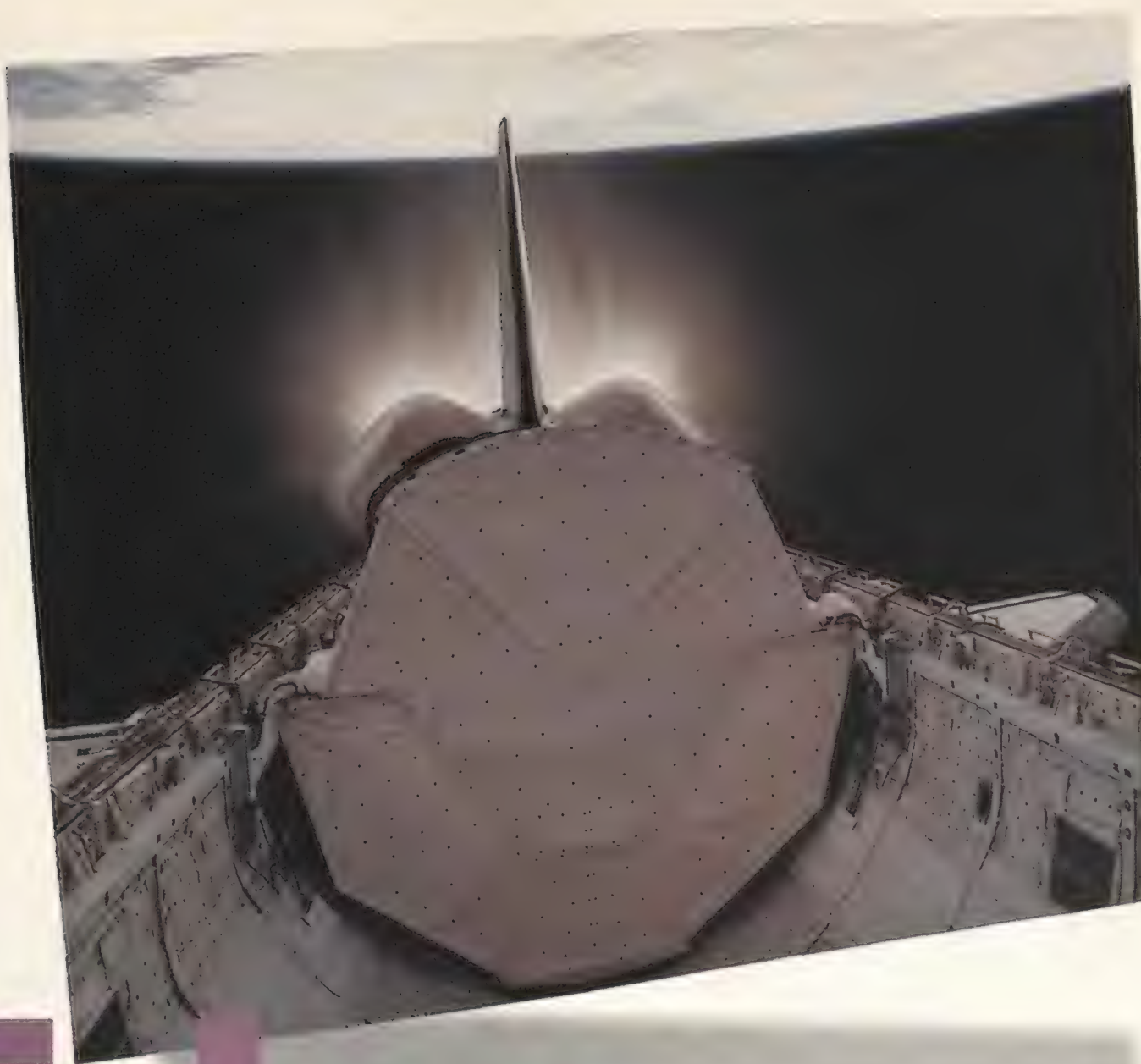
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A dramatic night-time photograph of a space shuttle launch. The shuttle is ascending vertically, leaving a massive, bright orange and yellow plume of fire and white smoke. In the background, a large, dark structure with the number '100' in a stylized, glowing font is visible. The launch is reflected in the calm water in the foreground.

America's space shuttle reaches a milestone.

Nineteen years ago, when the space shuttle stood ready for its maiden voyage, NASA hoped

it would make spaceflight routine. Today, 100 missions later, no one would claim that is the case. There is still something terrifying, something exhilarating, something impossible about the moment when a shuttle crew breaks gravity's shackles and sprints toward orbit. Over the course of nearly two decades, the shuttle has proved itself the most versatile spacecraft ever built. The numbers are impressive: More than 250 people and 54 species ferried into orbit, 2.65 million pounds of cargo delivered, 344 million miles traveled. Now the shuttle program faces its most demanding task yet—construction of the International Space Station, a job that will take several years. If the schedule holds, the shuttle's 100th mission—the fourth of these complex assembly flights—will prepare the way for the station's first crew to take occupancy this fall. In one sense it's the end of an era, now that the spaceplane is no longer NASA's primary focus. But this is what the space shuttle was built for. After all these years it finally has a destination, somewhere to shuttle to. For those of us who stay behind, there is a lingering question: What is it like to ride uphill in the belly of the beast, to live and work for days on end inside a research platform/observation post/space truck, and finally, to glide homeward in the world's fastest flying machine? The stories that follow offer a few insights from those who've been there.



Tales

from the Space Shuttle

ONE HUNDRED MISSIONS. AND EACH ONE HAS A STORY. *by Andrew Chaikin*

The First Passenger

On a bright, clear morning in November 1982, as Joe Allen climbed on board the space shuttle *Columbia*, he knew exactly what it would be like to fly in space. Or at least he thought he did. After all, he'd had a lot more time to think about it than most rookie astronauts. Allen had been one of 11 scientist-astronauts selected by NASA in 1967, before budget cuts killed the last planned Apollo missions to the moon and squashed any hope of going on to Mars. Allen's group had been waiting for their first spaceflights ever since, and felt a little left out. With self-deprecatory humor, they had nicknamed themselves "the XS-11." Now


Allen would finally find out what he'd been missing all those years.

"In my mind, I had a very clear image of what it was going to be like," he says. "Like a very high, fast airplane."

Even if the launch went exactly as he imagined, Allen would be breaking ground. Until now, shuttle missions had carried just two astronauts, the commander and the pilot. This time there would be four. As one of two so-called mission specialists on this fifth shuttle flight, officially designated STS-5, Allen was about to become the first space passenger. His three crewmates—mission commander Vance Brand, pilot Bob Overmyer, and fellow mission specialist (and XS-11 classmate) Bill Lenoir—would ride into space on the

shuttle's flight deck. All three of them had important roles to play during the launch, but Allen's duties wouldn't begin until *Columbia* reached orbit. For launch he would be "downstairs" on the orbiter's mid-deck, alone, with nothing to do but enjoy the ride. Once, when a journalist had asked him about his role during launch, he'd quipped, "I'll be in charge of religious activities."

Behind the scenes, though, launch contingencies had been a subject of serious discussion. *Columbia* had been designed to carry only two ejection seats. In an emergency, only Brand and Overmyer would have the option of saving themselves. Remarkably, Allen says the prospect of being left behind didn't seem unfair. "If fate is going to



Ulysses to the Sun
STS-41, 10/6/1990

Magellan to Venus
STS-30, 5/4/1989

Hubble Space
STS-31, 4/24/

The shuttle has deployed more than 60 payloads in orbit, including five major planetary probes and astronomical observatories.

AIR & SPACE

Smithsonian

Illustration by Harry Whitver
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Galileo to Jupiter
STS-34, 10/18/1989

100 Missions

Orbiting laboratory, heavy-lift launcher,
satellite rescue vehicle,
and finally taxi to the space station:
the remarkable, reusable
space shuttle.

THE 100TH: STS-92
A space station
assembly mission



Crew Compartment

The flight deck seats four (two stowable seats
behind the commander and pilot).

The mid-deck seats
three (stowable seats)

airlock

RCS
jets

stowage

horizontal
sleep cabins

vertical sleep cabin

United States

NASA
Discovery

Completion of
Orbital Operations
RCS orients orbiter
tail first and OMS
slows it for de-orbit.

2:00
Solid Rocket Booster
Separation

0:03-0:04
Roll to heading
for target orbit

0:00 Launch

Orbital Maneuvering/Reaction Control System

Pods on both sides of the orbiter's aft fuselage
house an Orbital Maneuvering System
engine, 14 Reaction Control System jets,
and their propellant systems.
The RCS jets (16 more are
located in the orbiter's nose)
control the orbiter in
pitch, roll, and yaw.

During OMS burns
engines gimbal to
maintain orbiter attitude.

RCS
helium tanks

RCS
fuel tank

OMS
fuel tank

RCS
oxidizer tank

OMS
oxidizer tank

OMS
helium tank

14 RCS jets

RCS turns orbiter nose first
for reentry

8:00-8:30
Main Engine Cutoff
External Tank Separation

Mission Profile

Orbit Insertion

At 400,000 feet, the orbiter is
maneuvered to wings level and a 40°
angle of attack for reentry. During entry, it
executes a series of turns to dissipate energy
and control descent rate and range.

At 49,000 feet, the orbiter is subsonic
and about 25 miles from
the runway.

H. Whitner

Mission ren



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be that evil to you," he explains, "and two people can live, go ahead and do it." Allen says that he and Lenoir told Brand and Overmyer that if necessary, they shouldn't hesitate to eject.

But Brand was against it. He told NASA managers that no matter what happened, he and Overmyer wouldn't eject, and that he wanted the seats to be disabled before the flight. Says Allen, "He was never very confrontational; that's not his nature. But he confronted NASA right in the eye.... That was a deal breaker."

Only later did Allen learn why his commander had been so adamant. A study of British pilots who had flown in World War II had shown that the handful of fliers who had survived a deadly attack by jumping when their crews could not had carried a heavy burden of guilt long after the war ended. "Vance was aware of this," says Allen, "and he wanted no part of it."

As it turned out, there was no need for ejection seats: *Columbia's* launch on November 11 was perfect. And it gave Allen the surprise of his life. The roar of the shuttle's solid rocket boosters was so intense that he later likened it to being inside a continuous explosion. "That's pretty overwhelming," he says. "A lot of it is the sound, and the vibrations that come with it." The feel-

Columbia's maneuvering engines fire in space (opposite). Bob Overmyer (sleeping) was the pilot on the first four-astronaut crew.



ing it produced was not alarm but exhilaration.

There was another surprise waiting in orbit: Allen realized that his preconception of a very high, fast airplane was all wrong. For one thing, as the shuttle coasted around the world there was no engine noise. Then there was the craft's orientation: Instead of flying wings level as an airplane does, it orbited at all sorts of odd angles.

"When you look out the windows," he says, "if you think you're going to look down underneath the wing to find the Earth, you're wrong."

In fact, says Allen, "My most overwhelming impression upon getting into space was that it was not airplane-like. It was like being at sea in a silent ship." The nautical feel was enhanced by the occasional sounds of the orbiter's hull creaking and popping in the harsh sunlight of space.

But the biggest surprise lay outside the shuttle's windows. When Allen looked at Earth, he could imagine himself in the gondola of some impossibly high-flying balloon. To his amazement, his senses couldn't tell him whether he was speeding over the planet at five miles per second or suspended motionless above the surface. "Pleasure" doesn't begin to describe the experience of seeing Earth from space, says Allen. "I was at a point where I was almost brain-numb," he recalls. "I just couldn't soak it in.... I was still in a state of shock when I returned."

He also returned with a sense of satisfaction: His crew had launched commercial satellites from a shuttle for the first time, an important milestone for NASA's new spacecraft. A photograph of Allen and his crewmates afterward shows them holding a sign that reads, "Ace Trucking Company: We Deliver."

One Golden Moment

Of all the space records waiting to be broken, none was less desirable. No astronaut wanted to go down in the record books as having suffered through the most postponed launch attempts. But as commander of his second spaceflight, STS 61-C, Robert "Hoot" Gibson won



Joe Allen, who had waited 15 years to reach orbit, was stunned by the beauty of Earth as seen from the shuttle's windows.

that distinction, a fact he admits good-naturedly. "That mission was *the* hardest to get off the ground," Gibson recalls. "We took five tries to get off the launch pad."

At the end of 1985, the shuttle was coming off its busiest year ever: nine launches, a record that still stands. Mission 61-C was almost the 10th, but a hydraulic problem halted the December 19 countdown just seconds before the main engines were due to ignite. A valve problem in the liquid oxygen system thwarted the next attempt. Then there was bad weather at the contingency landing sites. Next time out there was trouble with a main engine pre-valve. Then rain at the Cape. Finally, on January 12, 1986, Gibson and his crew left Earth.

No sooner had the astronauts reached



Hoot Gibson (far right) and his 61-C crewmates closed out the pre-Challenger era with one last, memorable nighttime pass over the United States.

orbit than mission control told them they'd have to come home a day earlier than planned—not because anything was wrong, but because planners were worried about getting behind on NASA's ambitious launch schedule for 1986 (which was to be even busier than the previous year), beginning with the launch of *Challenger* and a crew of seven, including schoolteacher Christa McAuliffe, in January.

The crew accepted NASA's decision. But, says Gibson, "we were just as hard to get down" as they had been to launch.

On January 16, having deployed an RCA communications satellite, Gibson's crew prepared to land at the shuttle runway at Cape Canaveral. When the weather at the Cape took a turn for the worse, Houston gave *Columbia* a wave-off and the astronauts readied for a landing at the backup site, California's Edwards Air Force Base. When the weather at Edwards also proved unacceptable, Houston radioed word that the landing would be postponed for a day.

That, explains Gibson, is no small task. "The amount of work that it takes to get the space shuttle ready to come down and land is really staggering," he says. The crew had spent the day before landing stowing cameras, experiments, and other gear. Soon after awakening on landing day, they'd become immersed in four to five hours of preparations for the large, backward-facing engine burn that would drop them out

of orbit. When mission control sent up word of the postponement, they spent another three hours returning the craft to normal operating conditions.

The next day, January 17, they repeated the entire process—and again they were waved off at both the Cape and Edwards because of weather. By now, Gibson says, the psychological buildup and letdown were beginning to take their toll. "You're sitting in the seats, ready to come home, ready to see your wife and kids again.... We'd done all that two days in a row."

That evening, before going to sleep, Gibson masked his fatigue as he and his copilot, Charlie Bolden, entertained mission control with a ditty, in two-part harmony, they had composed to the tune of the Rodgers and Hart song "Where or When":

Some things that happened for the first time

Seem to be happening again

And so it seems we will de-orbit burn

Return to Earth and land sometime

But who knows where or when.

On January 18 Gibson's crew were in their places again—and again they were waved off, for the fifth time, because the weather at the Cape was still bad. But Edwards was clear, and Houston gave *Columbia* the go-ahead to land there. Suddenly, the tension in *Columbia*'s cabin evaporated. With one more orbit to go before the de-or-

bit burn, there was nothing to do but wait. Gibson knew that in 90 minutes he would face the first unscheduled night landing in the shuttle program. But he couldn't have felt less worried.

"I will forever remember the relaxation that we felt," Gibson says. "We had about 30 to 40 minutes. And we proceeded to track across the southern United States, several hours before dawn.... It was a beautiful, absolutely wonderful clear night, everywhere across the United States—except in Florida, where we wanted to land. And we got to watch the city lights of San Diego and Los Angeles pop up as we came over the west coast. We got to watch Phoenix and Tucson go by. We got to watch El Paso go by. Spectacular. Just absolutely spectacular.

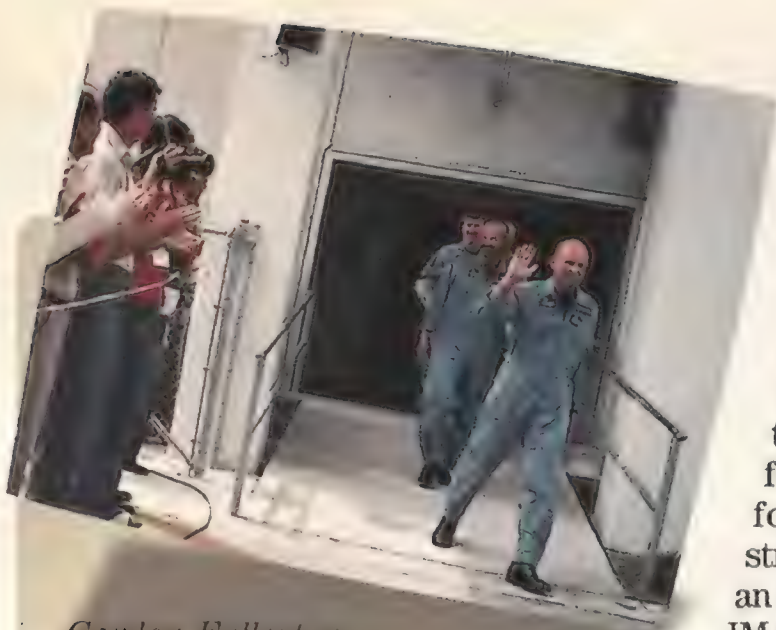
"There was not a whole lot of discussion going on," Gibson says. "Everybody was pretty much transfixed, looking out the forward windows of the shuttle and just watching the U.S.A. go by us, in the dark, before sunrise, this one last orbit that we had up in space." He looks back on that experience, communing with the view of the nighttime Earth, as a moment of innocence for the entire shuttle program. "We were looking forward to such great things in '86," Gibson says. "Little did we know what was about to happen to us in just 10 days."

Fences

They've been talking about it since the early days of space travel: the "no borders" effect. You get into orbit, the astronauts say, and you find that the boundaries printed on the schoolroom globe aren't there. From space, they say, the idea of nations existing separate from one another is just that, an idea. And when she made her first spaceflight in October 1984, Kathy Sullivan finally understood what her colleagues had been talking about.

"It was the first time I ever saw [Earth] in a way that told me, 'This is a place. It's not your place; it's not my place,'" she says. "It was a shift of perspective to recognize scales of unity that aren't apparent in daily human experience. That's definitely there. Very strong and compelling."

But an equally strong and opposing realization came to Sullivan as she float-



Gordon Fullerton and the 51-F crew head to the launch pad—and the shuttle's only abort to orbit—in 1985. Below: This switch in the orbiter cockpit selects a pre-programmed abort sequence.



ed at the shuttle's windows. "You'd also have to be trying *not* to notice all the many ways that we make ourselves visible and...our divisions and boundaries visible." Because of minor variations in land and water usage in different nations, Sullivan says, borders are often easy to see from space. Looking down from an orbiting shuttle she has spotted the Arab-Israeli treaty boundary, the border between California and Mexico, and the place where the northern United States meets the Canadian prairie.

Everywhere, Sullivan saw these unmistakable signs of separateness. "You see these places where we have drawn lines that say, 'This is mine, and this is yours, and don't you come over.'"

Some places, though, can't be fenced in. On her third flight, STS-45, in 1992, there was an IMAX large-format camera on board *Atlantis*, and Sullivan had a secret task: to get the first wide-screen movies of the Himalayas from space. On Earth, the assignment was known only to an eager group of filmmakers waiting in a back room of mission control. Before the flight, which was ded-

icated to studies of Earth's atmosphere, they had pleaded with her to get the shot, and she had figured out that there would be a perfect opportunity—during her sleep period. Officially, sleep time was off limits for scheduling tasks; there are strict rules against interfering with an astronaut's rest. But she told the IMAX team she would try anyway, under one condition.

"They really wanted the Himalayas," Sullivan remembers. "I said, 'Here's the deal. You say nothing, ever, to nobody. I'll try. If it doesn't come out, you never get to whine to anybody.' " And if it did come out, Sullivan would let them know, in some kind of code language, over the air-to-ground radio.

When the time came, Sullivan woke herself with a wristwatch alarm, then floated upstairs to the flight deck. As the orbiter passed over the Tibetan plateau, she flipped the switch to start the IMAX camera, which was mounted in the payload bay. Alone, with the view of space to herself, she watched as the world's highest peaks filled the overhead windows.

The next day she got on the radio and asked mission control, "Would you

let Payloads know we had a great night over the Himalayas." Of course, the code wasn't very tough for listeners on Earth to crack. But, Sullivan says, "at that point it didn't matter."

Limping Into Orbit

Machines fail. Long before the shuttle's maiden voyage, that simple thought was on the minds of NASA engineers and mission planners, especially when it came to the orbiter's three main rocket engines. Designed to operate at variable thrust and at higher temperatures and pressures than any previous rocket engine—then to keep doing it for more than 50 flights—the shuttle engines represented the state of the art in rocket technology (see "27,000 Seconds in Hell," Oct./Nov. 1998). Shuttle crews, themselves only too aware of the fallibility of machines, spend much of their training preparing for the unexpected, and it only makes sense that many of the simulations focus on how to handle a main engine malfunction during launch.

Gordon Fullerton had practiced many a failure scenario as he prepared to command mission 51-F in July 1985. He knew that if an engine failed relatively late in the launch, when the shut-



Kathy Sullivan uses an IMAX camera in 1990. Two years later she photographed the Himalayas from orbit—on the sly.



The view (in this case, the Nile River delta) from 200 miles up: Astronauts see no national boundaries, but plenty of evidence of separation.

tle had accelerated to very high speed, he and his crew could coax the orbiter to a landing in Spain or Africa—the option called Transatlantic abort, or TAL in NASA-ese. But if not, they would have to attempt the hairiest space maneuver ever devised: the Return To Launch Site abort, or RTLS. After letting the twin solid rocket boosters burn to depletion, Fullerton would have to fly the orbiter in a gigantic U-turn. Then he would have to ditch the shuttle's silo-size external fuel tank before reentering the atmosphere, finally steering to a landing at a special runway at Cape Canaveral. One shuttle commander dubbed it "two miracles followed by an act of God."

When Fullerton and his crew climbed into *Challenger* on July 12, they were ready for anything, even an RTLS abort. But they never made it off the ground. Just seconds after the main engines roared to life, they shut down again—with only three seconds to go before liftoff. For 20 minutes the crew could feel the orbiter rocking back and forth on the points attaching it to the external tank. Fortunately, nothing else went wrong. Ground controllers determined that the failure of a coolant valve in the number two engine had triggered the shutdown.

On July 29, Fullerton was in the commander's seat once more; this time *Challenger* rose from the pad. All was normal for the first five minutes and 45 seconds of the flight; then Fullerton and his crew felt a sudden deceleration from 3 Gs to 2 and heard an alarm signal in their headphones. The number one engine had shut down. From mission control, a message was transmitted to *Challenger* that had never been heard during a U.S. space launch: "Abort ATO."

"When it happened," Fullerton says, "I had a brief, 'This can't be happening' feeling." In Houston, the families of the astronauts reacted with fear and frustration, believing the mission was over. It wasn't. "Abort ATO" meant Abort To Orbit. At that moment, almost halfway to space, *Challenger* was past the point when it could return to Florida. A transatlantic abort was still possible but not yet necessary. *Challenger* could still limp into orbit on two engines—if they kept working.

In mission control, Jenny Stein, the flight controller monitoring the shuttle's engines, had seen an indication that the number one engine was overheating before it was shut down by the orbiter's automatic system. Now a sec-

ond engine was threatening to exceed its temperature limits. If it too shut down, a TAL would be mandatory—if it could even be accomplished.


Within seconds, Stein surmised—correctly—that the problem was in the temperature sensor, not in the engines themselves. At her recommendation, Fullerton's crew disabled the automatic shutdown mechanism and kept going. Firing the orbiter's maneuvering thrusters along the way to lighten the spacecraft's fuel load, the crew made it into orbit and were able to complete most of the mission's space physics and astronomy observations.

Only later, after the crisis was past, did Fullerton realize he'd been through it all before—in the simulator in Houston, just days earlier, during a final round of training exercises with mission control. "There's almost always a launch simulation," Fullerton says, "and the failure simulated was almost precisely what we had." In the actual abort, Fullerton realized, he and his crew had done better than they had on the ground. During practice, they'd always forgotten to start a stopwatch at the moment of engine failure, which was supposed to serve as a backup timer for determining when to shut down the engines. When the real thing happened, Fullerton says, "I'm happy to report we did start the watch."

Looking back, it was one of the more harrowing moments in the history of human spaceflight. Had Stein been wrong and a second engine overheated, but without the automatic shutdown mechanism enabled, the engine could have exploded. But Fullerton doesn't carry around the memory of a narrow escape.

"At the end of it all," he says, "it was an interesting thing to talk about, but I don't think anybody felt they'd just dodged certain death or anything like that. It was a feeling of relief—'Everything's stable, let's get on with it.'"

There was one twist for which Fullerton is thankful. He's happy he didn't have to make that emergency landing in Spain. "If we'd had that failure 30 seconds sooner," he says, "we would've had a TAL abort, and a night landing with 4,000-foot overcast and raining." He adds wryly, "That would've been an even better story." —

A dramatic photograph of the Space Shuttle Columbia being launched at night. The shuttle is oriented vertically, with its white orbiter and external tank and solid rocket boosters clearly visible. A massive plume of fire and white smoke billows from the base of the shuttle, illuminating the launch pad. The orbiter's nose is pointed upwards, and the word "USA" is visible on the side of the white section. The background is dark, emphasizing the bright light of the launch.

AIR & SPACE

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An Air & Space/Smithsonian Guide

Go for Launch!

by Nan Chase

PLAN A TRIP TO CAPE CANAVERAL TO SEE THE SPACE SHUTTLE TAKE OFF. (AND CHECK OUT WHAT ELSE THE SPACE COAST HAS TO OFFER.)

A visit to Kennedy Space Center and Cape Canaveral means a chance to hobnob with astronauts—both faux and real—and get a close look at legendary rockets. Right: The author and kids in 1991.

This story doesn't have a happy ending. It doesn't have an ending at all, in fact, just a bold and brilliant opening scene and a plot that continually rockets into vast, unknown territories.

I'm talking space launch. Space fever, you might say, which lurked within me like a virus for more than a decade, from the time I first saw an old Saturn V rocket at Kennedy Space Center until the bug flared up last summer and I managed—almost—to watch the launch of NASA's space shuttle *Endeavour* last winter.

A photo from that first visit to Florida's Space Coast—72 miles of seashore dotted with theme parks, wildlife refuges, and launch pads—shows a younger me

with my three sunburned children, dwarfed beneath the nozzles of the 363-foot-long rocket, which at that time was displayed outdoors, part of the space center's tourist circuit. I was bowled over by the rocket's immensity, and vowed to return someday and experience the thrill of a launch.

When my second child left for college last year, I decided to return to Florida to watch a shuttle lift off. Some shuttle missions leave the pad after a minimum of delay, but it took months of tracking launch dates almost daily on NASA's Web site, through numerous postponements, before

I felt confident enough to buy my ticket to Orlando for the launch of STS-99, which was a mission to deploy a new Earth-mapping radar. Launch date: January 31.

Okay, so *Endeavour* didn't fly until February 11, and by then I was back home. But launch or no launch, my four-day visit to the Kennedy Space Center and neighboring Cape Canaveral Air Force Station, and to the towns, beaches, and wilderness areas beyond, provided a marvelous look at the first 50 years of America's space program...and a glimpse into the international future of celestial exploration.

When President Harry Truman created the Joint Long Range Proving Ground in 1949 (see "The Year the Rockets Came," Apr./May 1999), the government took over a sparsely populated finger of land called Cape Canaveral, which juts into the Atlantic Ocean halfway down Florida's east coast. The Army, Navy, and Air Force could now test-fire their rockets—which included German V-2s—safely over the ocean. A combination of marsh and tropical scrub, Cape Canaveral and neighboring Merritt Island lie in the lowlands of the Indian River, Banana River, and aptly named Mosquito Lagoon, an area visited as early as 1513 by Spanish explorers.



COURTESY NAN CHASE



KSC VISITOR COMPLEX

NASA today controls the 140,000-acre John F. Kennedy Space Center, which shares Merritt Island with Merritt Island National Wildlife Refuge and Canaveral National Seashore. Cape Canaveral Air Force Station, occupying the easternmost part of the cape, falls under Air Force jurisdiction. Shuttle launches take place at KSC launch pads 39A and B—while commercial satellite launches and most Air Force rockets leave from Cape Canaveral, where America's early spaceflights began (see map, p. 35). Tourists are not allowed unescorted on Cape Canaveral Air Force Station, and access is restricted to KSC's northern gate.

The best way to understand the lay of the land is to spend a day at the visitor complex and on the tour buses that go to the unrestricted portions of KSC. An important rule for planning a trip around a space launch: On launch days, regular tour bus activities and visits to the Air Force museum cease until the rocket clears the tower (Canaveral National Seashore follows more restrictive rules). On launch days, therefore, visitors can't see some of the most interesting aspects of the cape, so they should either try to arrive a day early or stay a day late.

A private contractor operates the space-related tourist attractions, mostly at KSC but with side trips to the Air Force Space and Missile Museum and other points of interest on Cape Canaveral. The \$26 adult ticket price at KSC covers unlimited access to the exhibits and admission to two IMAX films; comfortable bus transportation to see the Vehicle Assembly Building, shuttle launch pads, and International Space Station Center; and a visit to the Apollo/Saturn V center.

Worth three or four hours on its own—eight, if you're a real space buff and have the stamina—the visitor complex is full of treats: The children's exhibits are shiny and interactive, the IMAX screens dwarf the ones at your local multiplex, and there's air-conditioned comfort in the summer. I particularly enjoyed the quiet exhibits at the park's edges—the new hall of Early Space Ex-

ploration (a wasp-like Soyuz craft hangs from the ceiling, and the actual Mercury mission control room is reassembled behind glass), the "rocket garden," and the shuttle plaza with its full-size, walk-through model of the orbiter. I found the launch status center especially lively: A staff member gave updates of launch activities hourly and demonstrated shuttle operations. A new program at the visitor complex has started since my visit: Astronaut Encounter, which offers an actual been-in-space astronaut on hand to answer questions.



ALL STUDIO PHOTOGRAPHS BY ERIC LONG

How Do I See a Launch?

Before leaving home, check in with NASA's Web site, www.nasa.gov, for launch and landing dates (click on "See a Launch" and "Launch Schedule"). Cape Canaveral telephone hotlines include 321-872-7200, Category 1065 (Cape Canaveral unmanned launches), 321-867-4636, or 800-KSC-INFO (the latter two cover shuttle launches and landings). Important: Because launch dates change frequently, you may want to invest in a full-price airline ticket to Florida that allows changes without penalty. The Space Coast is served by airports in Orlando and Melbourne, Florida. Other resources:

Local newspapers print updated launch and landing information, and the Launch Information Service and Amateur Television System (LISATS) transmits cover-

age of launch and landing activity, starting about three hours before liftoff. In addition, amateur radio enthusiasts can tune into 421.75 Megahertz.

Space Coast Office of Tourism, Cape Canaveral, FL; phone 800-936-2326; Web site: www.space-coast.com.

Kennedy Space Center Visitor Complex, Kennedy Space Center, FL; phone 321-452-2121; Web site: www.kennedyspacecenter.com. "Maximum Access" badge, \$20–\$26. Special tours include "Cape Canaveral Then and Now," which highlights both the Apollo era and current shuttle operations, and "Kennedy Space Center Wildlife Tour," each \$35 per person, reservations required.

Brevard Community College Planetarium, Cocoa, FL; phone 321-632-1111; Web site: www.brevard.cc.fl.us/~planet. Admission: \$3–\$12. Shows on Tuesday, Friday, Saturday.

U.S. SPACECAMP Florida, main offices in Huntsville, AL; phone 800-63-SPACE; Web site: www.spacecamp.com or www.dogfite.com (Aviation Challenge).

U.S. Astronaut Hall of Fame, Titusville, FL; phone: 321-269-6101, Web site: www.astronauts.org. Admission: \$9.95–\$13.95.

Air Force Space and Missile Museum, Cape Canaveral Air Force Station: public access by KSC tour (see above). For group tour availability, call Patrick Air Force Base: 321-494-5933.



KSC VISITOR COMPLEX

An errant landing? The Kennedy Space Center Visitors' Center is the gateway to NASA history, as well as an up-close look at the shuttle.

What to Wear

The launch "window" can last from a few minutes to a few hours—at any time of day or night—so visitors may have to dress for a variety of conditions. Here's what veteran launch watchers say:

In summer, wear maximum strength insect repellent, and lots of it. Use plenty of sunscreen and wear a hat, long-sleeved loose-fitting clothing, and sturdy shoes with socks.

In winter, night launches can be cold and damp even if daytime temperatures are moderate. Bring a heavy coat, gloves, hat, and even long underwear.

Think picnic mode at all times, since many viewing spots don't have food available at 3 a.m. Bring water, coffee, or juice, and sandwiches and snacks—and be prepared to carry out all your trash.

Binoculars are a must, and a folding camp chair is helpful.

On to the tour buses. In the Alice-in-Wonderland atmosphere of KSC, the buses seem the size of ants. They drive past the gargantuan Vehicle Assembly Building, where external fuel tanks, solid rocket boosters, and shuttle orbiters are joined together before transfer to the launch pads—upright—via ultra-heavy-duty crawlers. The tour buses also take visitors to an observation gantry just a mile from Complex 39—the closest public view of the mesmerizing shuttle vehicles poised for liftoff—and they stop at the International Space Station Center. There, a glass wall allows viewing of complex payloads from the 16 countries cooperating on the station in their final testing stages before launching.

The Apollo/Saturn V Center is a big, big wow. (How big? The Saturn V rocket—an enduring symbol of the space race that first landed man on the moon—is nearly twice as tall as the space shuttle and its external fuel tank.) The huge rocket I had seen outdoors in the 1990s was restored and brought inside its own building in 1997 (see "Saturn Rising," Dec. 1996/Jan. 1997). Visitors enter through a multi-media theater, where an authentic reconstruction of an Apollo firing room has been installed, telephones and all—a potent element of

nostalgia. Following a goosebump-producing film, visitors pass to the rocket display amid shouts of "Whoa!" and "Man!" In addition to the Saturn, the gigantic display contains a Lunar Excursion Module—the lander that took two astronauts at a time to the moon's surface—and an actual Apollo command module.

After my tour, there was just time before sunset to cruise in my rented convertible down the seaside State Road A1A, where, legend has it, the earliest astronauts used to drag race *their* convertibles. History is everywhere.

Launch day had "scrub" written all over it: rain, wind, low clouds. *Endeavour* had a two-hour launch window, 12:47 to 2:49 p.m. Monday, and a similar slot on Tuesday. Since KSC's usual bus trips for this mission had been pulled unexpectedly, I decided to watch the launch at nearby Cocoa Beach; there's good viewing from the municipal pier. At 3 p.m. I gave up and headed back to Merritt Island to see the Astronaut Hall of Fame, which I had missed on Sunday. In the end, a mission-busting computer glitch gave me more time for sightseeing.

The Hall of Fame was worth missing, I'm afraid. The orientation appeals mainly to those whose interest in the space program ended around 1971. However, the site houses the popular Space Camp for kids, and there are several cool rides, including a zero-gravity simulator.

Tuesday's launch was scrubbed too, although I was the last to know; I had skipped the morning news because the day dawned so fair that I assumed *Endeavour* was "go" for liftoff. But the software problems of the previous day would delay launch for at least a week. I was lost in a fog of disappointment until I was revived by the spectacular weather: 75 degrees and sunny. I lowered the convertible top and headed north to console myself with some bird watching.

The geographic isolation that launched the space program also attracts wildlife. Hundreds of spectacular bird species populate the watery peninsula, and the warm canals shelter manatees. Rare creatures like the Florida panther appear surprisingly often, and sea turtles



Launch Viewing Sites

- | | |
|---|--------------------------|
| 1 Merritt Island National Wildlife Refuge | 6 KSC Visitor Complex |
| 2 Playalinda Beach | 7 NASA Causeway East |
| 3 Space View Park | 8 Jetty Park |
| 4 Rotary River Front Park | 9 Cherie Down Park |
| 5 Astronaut Hall of Fame | 10 Cocoa Beach Shoreline |

(closed during shuttle launches)

Launch Pad 39 B

Launch Pad 39 A

Complex 41
Titan IV & Titan/Centaur
(Active, USAF)

South Boundary - KSC
North Boundary - CCAS

Launch Complex 40
Titan IV
(Active, USAF & Commercial)

Launch Complex 37
Pads A&B
Apollo/Saturn 1&1B
(Dismantled)

Launch Complex 34
Apollo/Saturn 1&1B
(Dismantled)

Launch Complex 20
Suborbital
(Active, USAF
& Commercial)

Mercury
Memorial

Launch Complex 14
Mercury/Atlas
(Dismantled)
(1st Orbital Launch)

Launch Complex 46
(Active, Navy
& Commercial)

Launch Complex 17
Pads A&B
Delta
(Active, USAF
& Commercial)

Launch Complex 36
Pads A&B
Atlas I&II
(Atlas Centaur)
(Active, USAF
& Commercial)

Air Force Space Museum
Launch Complex 26
Jupiter/Juno (Inactive)
Launch Complex 5/6
NASA, Mercury (Dismantled)
(1st Manned Launch 5/5/61)

Port Canaveral

City of Cape Canaveral

KSC Industrial Area

International
Space Station Pro-
cessing Center

Astronauts'
Memorial

KSC Visitor
Complex

Merritt
Island

Shuttle
Landing
Facility

Apollo/Saturn V
Center

Vehicle
Assembly
Building

Indian River

NASA Causeway West

405

528

Planetarium

Haulover Canal

Canaveral National Seashore

Mosquito Lagoon

Blackpoint
Wildlife Dr.

Tinsville Rd.



KSC VISITOR COMPLEX

Inside the Apollo/Saturn V Center, the main attraction is the rocket that sent astronauts to the moon. Each F-1 engine in the Saturn booster produced 1.5 million pounds of thrust. The center also houses a lunar lander and an Apollo control room mockup.

lay their eggs on the beach.

I drove first to Haulover Canal, at the northern edge of Merritt Island National Wildlife Refuge, so pristine that I expected Spanish explorers to emerge from the palmettos any moment. The manatees congregate, up to 40 at a time, near a free public observation

deck. Here's where I may try to watch my next launch—the shuttle will appear to blast out of the jungle.

A few miles away, Black Point Wildlife Drive drew me in. I stopped often on the sandy seven-mile loop to use my binoculars and camera. A vast array of birds moved over the wind-swept marshland, an entrancing spectacle. Not a bad place to watch a shuttle launch either.

A few miles to the east, the Playalinda Beach entrance to Canaveral National Seashore had reopened, so I got to spend an hour at the surf before sunset. From a point just off the beach there's a great view of launch pads 39A and 39B in the middle distance—and it's free with park admission.

Tuesday night is one of three performance nights at the Brevard Community College Planetarium, so after an early dinner I headed to the town of Cocoa. The fine planetarium and observatory are community assets reflecting the local affection for the space program. I enjoyed both the colorful star show about the Hubble telescope's discoveries projected on the 70-foot dome and the big-screen nature movie shown in another part of the complex. Afterward I spent half an hour in the observatory upstairs, peering at stars and planets as the friendly attendant described the telescopes.

Time was getting short. Before my flight home I had time to visit the Air Force Space and Missile Museum at Cape Canaveral Air Force Station, and

Wildlife Watching

In addition to public parks, a number of private tour operators can take visitors into the wilds of the Space Coast:

Merritt Island National Wildlife Refuge, Titusville, FL, off State Road 402; phone 321-861-0667; Web site: merrittisland.fws.gov.

Canaveral National Seashore; north district office, phone 904-428-3384; south district office, phone 321-867-0677 or 321-867-4077.

Space Coast Nature Tours Titusville, FL; phone 321-267-4551; Web site: www.spacecoastnaturetours.com.

Various local guided tours, including horseback riding, photo safaris, lunch with dolphins, airboat tours, phone 407-725-0796.

Fishing expeditions, including both salt and freshwater fishing; Space Coast Office of Tourism: phone 800-936-2326; Web site: www.space-coast.com.



much to my surprise, its quiet appeal outshone the flashier facilities at KSC. In addition, the ghosts of famous launch pads—now just rusting hulks along the beach—reached out from the past and touched me with their mute power.

I had been lucky enough to get an introduction to Johnny Johnson—a.k.a. Lieutenant Colonel John Johnson (U.S. Air Force, ret.)—one of half a dozen volunteer tour guides. We had breakfast at an old-time space hangout called the Moon Hut on State Road A1A, then headed out. The Moon Hut is a space attraction in itself, its walls covered with photos and memorabilia from the space race, and is reportedly still a place to rub shoulders with astronauts and other NASA types. Other local haunts can be found in “Eat, Drink, and Spot an Astronaut” (right).

After leaving the Moon Hut, Johnson and I headed to Canaveral for my tour. Private escorted tours are the exception; anyone can see the same sights on the “Then and Now” bus tour, which leaves from the KSC visitor center three times daily. The museum’s extensive grounds hold a collection of 55 historic missiles and early spacecraft. The Complex 26 blockhouse is more modest: Besides displays about serious aspects of rocket history and a mini-gift shop of unusual space memorabilia, you’ll see exhibits about chimps in space, and a shrine to Barbara Eden, who, as star of “I Dream of Jeannie,” attained Air Force cult status.

Most important are Firing Rooms A and B, where America’s early rocket launches were controlled, beginning in 1957. The panels, with their old-fashioned switches, knobs, vacuum tubes, and transistors, stand as a mini-museum of early computing. During launches the technicians and scientists were shielded behind 45 layers of glass, but outside, the firemen huddled in a sand dugout behind a short cinderblock wall just 100 feet from the blast.

Johnson drove me to the historic launch pads of manned space exploration too, and for just a few moments those eerie, lonesome places reverberated in my imagination with flame and sound. In the distance, today’s active Titan, Atlas, and Delta launch pads bustled with silent activity.

Unfortunately, it was time to catch

a flight back to North Carolina. I experienced my greatest regret not in Florida but back home 10 days later, as *Endeavour* streaked into space above its trademark roiling steam. Darn, I’d wanted to see that up close. Hear it. Feel it. So I’ll keep going back. As I found out, there’s always plenty to do if the launch is delayed. ➔



Eat, Drink, and Spot an Astronaut

In the days of yore, astronauts cut a wide recreational swath through the towns close to Cape Canaveral. Although the wild seaside carousing may be a thing of the past, it’s still possible to bump into some famous fliers at these hangouts:

The Moon Hut, 7802 Astronaut Blvd. (State Road A1A), town of Cape Canaveral. Open daily from 5:30 a.m. to midnight, serving breakfast, lunch, and dinner anytime, this friendly cafe dates from the earliest days of the Cape and features walls covered with memorabilia. Phone 321-868-2638.

Shuttle Bar & Grill, 6100 N. Courtenay Parkway, Merritt Island. Just five miles south of Kennedy Space Center on State Road 3. Open daily for lunch and dinner, lunch only on Sundays. Phone 321-453-2320.

Fat Boy’s Bar-B-Q, 6006 N. Atlantic Ave. (A1A), town of Cape Canaveral. John Glenn returned here for lunch and greetings before his 1998 flight. Open daily for lunch and dinner. Phone 321-783-7142.

Bernard’s Surf, 2 S. Atlantic Ave. (A1A), Cocoa Beach. Memorabilia abounds; serving lunch and dinner daily. Phone 321-783-2401.

Rusty’s Seafood & Oyster Bar, 628 Glen Cheek Drive., Port Canaveral. Serving lunch and dinner daily. Phone 321-783-2033.

At the Kennedy Space Center, astronauts scheduled for flights often take visiting family members on personal tours and to lunch. Sightseers are likely to see them—in blue flight suits or with mission patches on polo shirts—at the Apollo V Center.

Astronaut Rick Searfoss fields high-minded questions from KSC visitors.



Space Shuttle Impersonation

A TRICKED-OUT BUSINESS JET TEACHES SHUTTLE COMMANDERS
HOW TO LAND THE WORLD'S ONLY 100-TON GLIDER.

by Debbie Gary *Illustrations by John MacNeill*

For a moment, at 28,000 feet, the aircraft floats, as the nose gently arcs downward through the starry sky. We are in one of NASA's Shuttle Training Aircraft, simulating shuttle commander Jim Halsell's next return from space. I lean on the doorframe as gravity lightens, then brace my feet and hang on as we plummet toward the ground. The main gear is down, the thrust reversers are deployed, and gravity shoves the crew against their seat harnesses. Cold air from the back of the aircraft spills down the aisle, past my legs, and into the cockpit.

Halsell, in the left seat, has no throttle and no engine gauges. On the left side of the cockpit, black window masking narrows his view. Colorful screens and a head-up display tell him he is maneuvering a 230,000-pound orbiter, which plunges toward the New Mexico desert floor like Wile E. Coyote in a Road Runner cartoon. In fact, we are in a highly modified Grumman Gulfstream II twin-engine business jet.

Halsell's right hand is on a control stick that looks, feels, and reacts like the rotational hand controller he will use to maneuver *Atlantis* from orbit back to Florida's Kennedy Space Cen-

ter, which he did last May 29, at 1:20 a.m. In the right seat, Steve Nagel is ready to kick the STA out of simulation mode if need be. His hands hover above the yoke, which, with the throttles and thrust reverser, moves back and forth as if with a mind of its own, commanded by computers in the back of the aircraft. From the jumpseat, flight simulation engineer Alyson Hickey calls out speeds, altitudes, and reminders. The altimeter unwinds cartoonishly and the vertical speed indicator says we are descending at a rate of 14,000 feet per minute.

Over the next hour, Halsell will shoot 10 intense two-minute approaches, coaching and critiquing himself on the most minute details of his performance. He seeks perfection.

When a pilot becomes a space shuttle commander, he faces two of the toughest minutes of his flying career: his first shuttle landing. Everyone who takes off in a single-seat airplane for the first time has to land an airplane he has never flown before. But add a few complications: The pilot is returning from weightlessness, fighting nausea and possibly vertigo, and feeling every force of gravity as if it were doubled. His balance is shot, and muscle mem-



or



ory, which pilots train so hard to build, has deserted him. He is encased in a full pressure suit, helmet, bulky gloves, and boots. The aircraft, a 115-ton glider, is worth \$2 billion. There are no go-arounds, in which a pilot can add power and make a second approach if he doesn't like the way the first one is going.

NASA has other simulators, ground-based ones programmed with thousands of possible situations and emergencies, where commanders and pilots

learn to fly a machine that is part rocket, part spacecraft, and part airplane. But in simulating the airplane part, none is as effective as the Shuttle Training Aircraft. STA instructors can throw only a few curves—lower than expected visibilities and cloud bases, navigation errors, and onboard display malfunctions—but this is the only simulator in which astronauts feel the crush of gravity, wind shear, turbulence, and that breathtaking sensation of ground rush, where Earth races toward you like a locomotive. From the instructor's seat, the craft flies like a normal airplane. From the commander's seat, it flies like the shuttle, thanks

to a bank of computers housed in blue cabinets in the cabin.

In the early phases of shuttle flight training, Nagel and the other instructors talk the students through an approach, but tonight Nagel is quiet. Halsell is a veteran, with two shuttle flights as pilot and two as commander, and he has flown 1,300 approaches in the STA. Nagel is also a veteran shuttle pilot and commander, having been in the astronaut corps for 17 years before retiring in 1995 to join NASA's Aircraft Operations Division as a pilot and instructor.

Halsell banks and spirals down, flying the Heading Alignment Cone, which leads the orbiter into a descent to intercept the final approach course. On his control stick Halsell makes tiny,

When commander Eileen Collins landed the shuttle for the first time in July 1999, she thought, *Is this going to be what I expect?* When she took over at 40,000 feet, her test pilot instincts kicked in. "You need to make very deliberate, small inputs," she says. She noted it would be easy to get into a pilot-induced oscillation, a porpoising, with a disastrous landing a distinct possibility. She told herself, *I'm going to keep an eye out for this when I get down low on the landing.*

nearly imperceptible pulse-like movements that are recorded on a roll of paper, which unwinds from the side panel next to Hickey. The paper graphs the flight path and every pulse of the stick, a record of which goes to the chief of the astronaut corps for post-flight scrutinizing. It also shows the angle of the STA's descent—18 degrees for heavier flights and 20 for lighter ones, up to seven times steeper than an airliner's descent angle.

In the cockpit, projected onto a clear panel in front of his windshield, the head-up display tells Halsell if he is on his intended flight path. The flight director software tells him to increase or decrease roll and pitch—"energy management" commands that ensure the aircraft will intercept the glideslope with the proper airspeed and altitude. When he rolls onto final approach, red and white lights on the ground also guide him. At this dive angle we are aimed 7,500 feet short of the runway. Following head-up display guidance, Halsell pulls the nose up and shallows the glide angle to 1.5 degrees when he passes through 2,000 feet. With the change in glide angle, the aircraft is now aimed 2,500 feet beyond the runway threshold. We begin to slow toward the shuttle's landing speed of 205 knots.

In front of us, the gigantic White Sands runway looms in a pool of light. Since the shuttle has no onboard landing lights, the landing zone is lit by high-intensity lights, which sit on flatbed trailers on either side of the approach end. Twenty feet above the runway Halsell pulls the nose up as if to land, but then levels off, holding the same eye level he will have when he lands the shuttle—"height of eyes," in astronaut speak. On Nagel's panel, a green square lights up. "Touchdown," he calls, kicking the STA out of computer simulation mode, and he climbs back up into the darkness to begin again.

Behind us, in another STA, Scott Horowitz flies the same approach with another training crew. Horowitz will be the pilot on Halsell's next mission. Both pilots are trained to fly the shuttle, in case a commander is incapacitated. The pilot functions somewhat like a copilot on an airliner, bringing perspective the commander may not have. "When you are involved in the

actual eye-to-hand coordination, you tend to get fixated on controlling one parameter," says Scott Altman, who was the pilot on mission STS-90, *Columbia*, which flew in April 1998. "But when you are sitting in the right seat you get a better big picture of what is going on. A lot of commanders use their pilots to back them up, to call altitudes, airspeeds, and to maybe give him your impression."

Pilots generally make two spaceflights before they move up to the commander's position. They will have made at least a thousand approaches in the STA, but they know that the only one that counts will be the one in which the dust flies as the rubber hits the tar.

In orbit, the shuttle's aerodynamic control surfaces—the rudder and the four elevons, which function as combined ailerons and elevators at the trailing edge of each wing—are nonfunctional. Maneuvering in orbit is accomplished by the reaction control system, which consists of 44 thrusters on the nose and tail. Pitch, roll, and yaw are accomplished by firing certain thrusters. Charlie Precourt, chief of the astronaut corps, compares maneuvering in orbit to sliding on ice: There is no resistance. So inputs, made with the rotational hand controller, are extremely small. When the shuttle reenters the atmosphere, the aerodynamic surfaces begin to exert an effect around 300,000 feet, phasing in completely by 120,000 feet. There is a brief overlap between thruster control and aerosurface control. Before the first powered flight, no one was sure how this transition would work. John Young, the first shuttle commander, helped find out.

Young had been an astronaut since 1962. On his fourth spaceflight, in 1972, he landed and took off from the moon as the spacecraft commander for Apollo 16. About piloting the shuttle through its transition from spacecraft to aircraft, he says, "We shot profiles based on what the X-15 was doing, but we were scared of how the elevon and rudder system and yaw jets were going to interact."

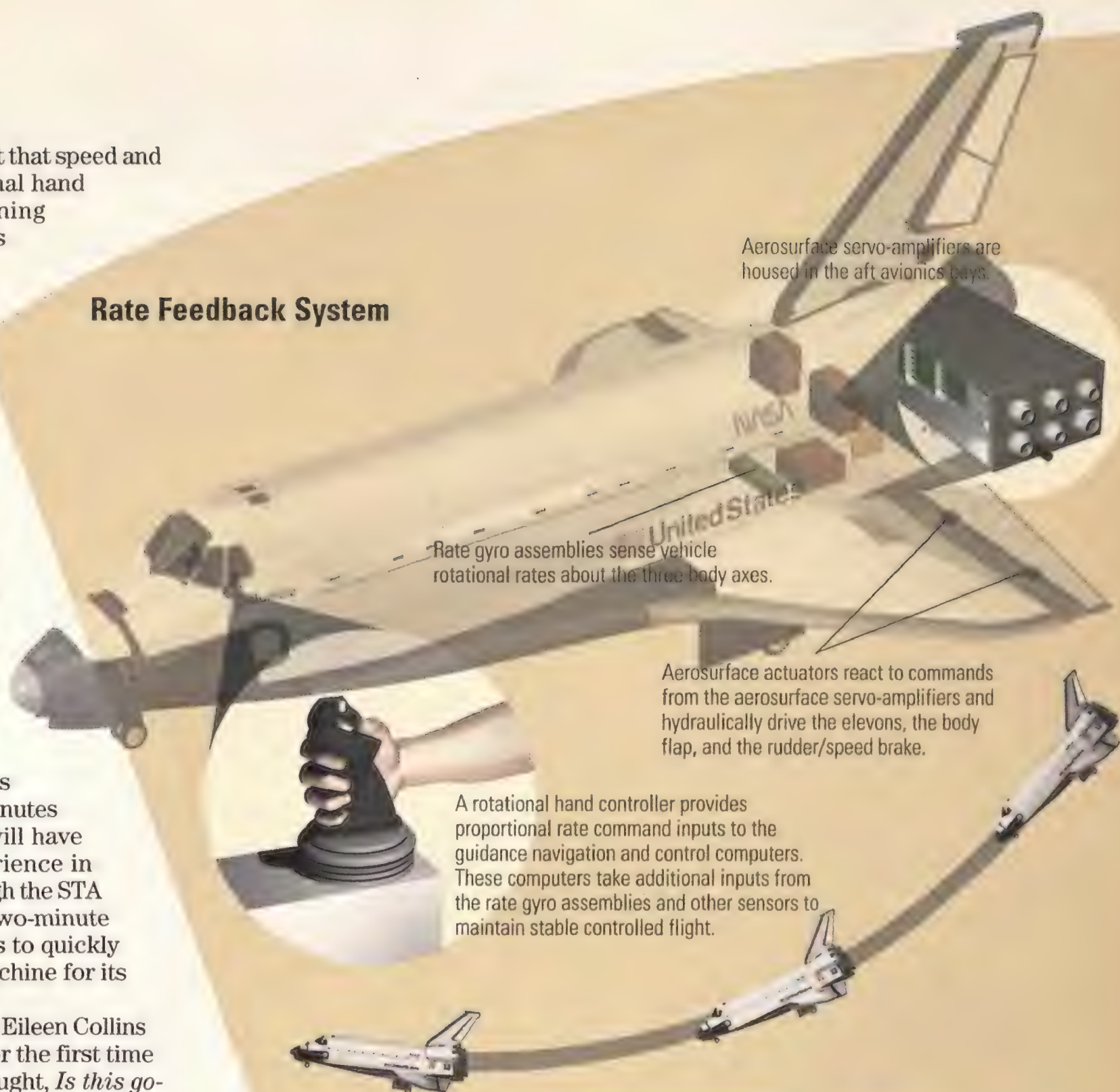
Today the commander takes control around Mach 1, but Young started testing the controls much sooner on that first shuttle flight in April 1981. "I was flying roll control from about Mach 6

on down," he says. At that speed and altitude, the rotational hand controller is governing both the aerosurfaces and the reaction control system as they phase in and out under commands from the aerogjet digital autopilot. "On the second mission, Joe Engle did push over/pull up maneuvers at very high Mach numbers" to test the pitch axis. "We found that you could take over anywhere, but the agreement now is a little past subsonic," says Young. These days, the commander takes over at about four minutes to touchdown. He will have had plenty of experience in the simulators (though the STA can provide only a two-minute ride), but he still has to quickly evaluate the real machine for its reactions.

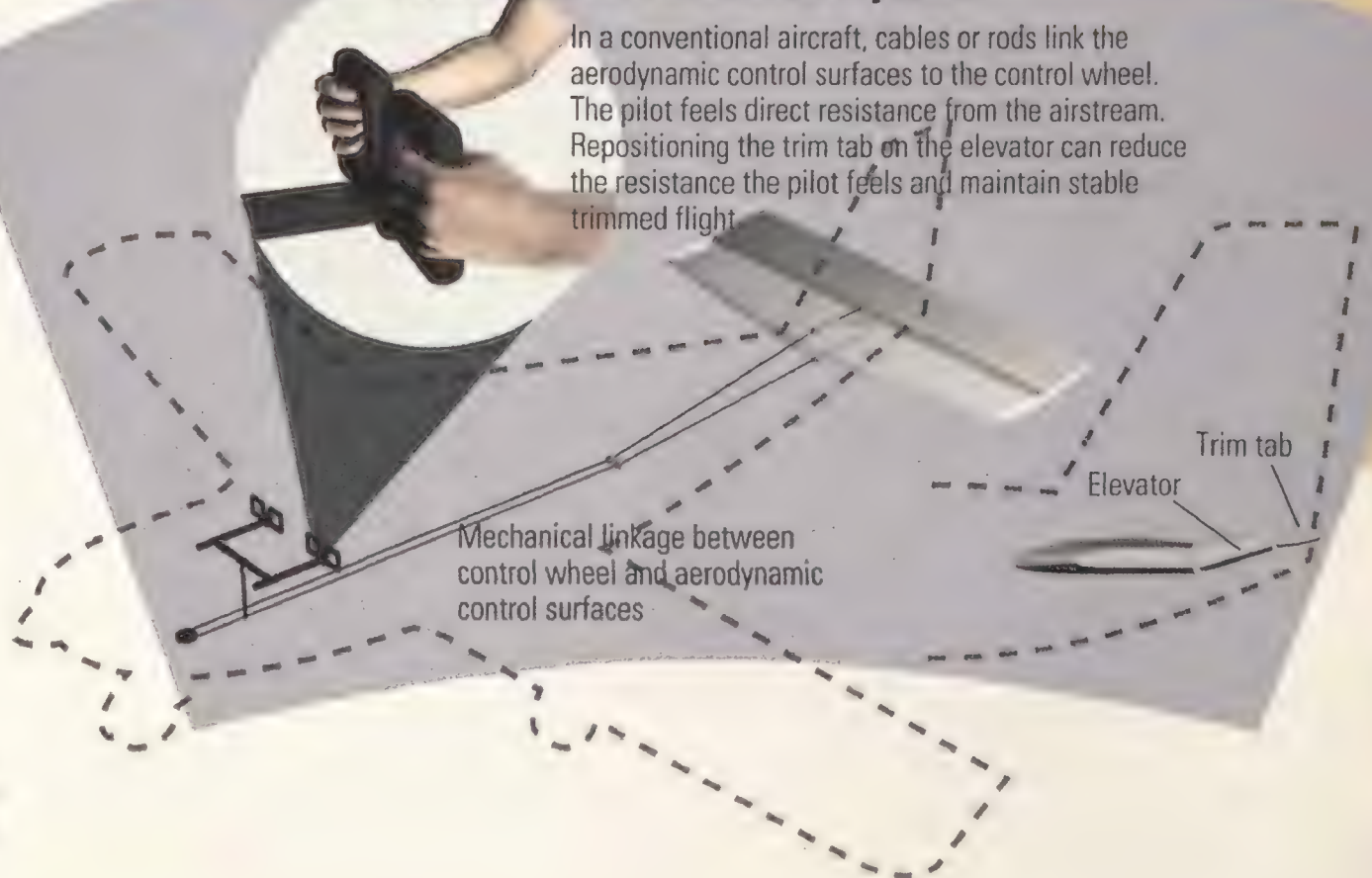
When commander Eileen Collins landed the shuttle for the first time in July 1999, she thought, *Is this going to be what I expect?* When she took over manually at 40,000 feet, her test pilot instincts kicked in. "I did some control inputs, trying to get a qualitative feel for it," she says. "In the pitch axis it was sensitive. You need to make very deliberate, small inputs." (Commanders say that in the pitch axis, the shuttle handles like a fighter; in the roll axis, it's more like a big transport.) She noted it would be easy to get into a pilot-induced oscillation, a porpoising, in which the pilot's inputs and the airplane's actions get out of synch, with a disastrous landing a distinct possibility. She told herself, *I'm going to keep an eye out for this when I get down low on the landing.*

"The controls take a bit of getting used to," says Charlie Precourt. "It's hard to compare to what the average

Rate Feedback System



Mechanical Feedback System



pilot flies. Most airplanes are on an attitude feedback system. The shuttle has a rate feedback system."

In a conventional aircraft, the pilot pulls or pushes on the control stick until the nose reaches the attitude he desires. The rate at which the nose moves is determined by how hard he pulls or pushes. It's a simple one-to-one ratio: The harder he pulls, the more the nose moves.

In such an attitude, or mechanical, feedback system, cables or rods link the control stick and the rudder pedals to the elevator, ailerons, and rudder. The forces acting on these aerodynamic control surfaces "feed back" to a pilot through the pressure he must exert on the control stick to climb, descend, or maintain straight-and-level flight. An elevator trim system—a small tab on the trailing edge of the elevator, connected by cable to the cockpit—is set to maintain a particular nose attitude.

An airplane is aerodynamically stable in the pitch axis—that is, it wants to remain in straight and level flight. If you lower the nose to descend, for example, while maintaining a constant airspeed, you will need to exert constant pressure on the control stick to counter the increased airflow over the elevator. By adjusting the trim tab to react against the changing lift force due to the increased airflow, the pilot re-balances, or "trims," the aircraft and no longer needs to exert pressure on the control stick to maintain a nose-down attitude.

This mechanical feedback system would be unmanageable in a hypersonic aircraft like the shuttle, which must maintain a steady nose-down position while its speed changes thousands of miles per hour in minutes. Instead of cables mechanically linking the control surfaces to the stick, computers transmit control input and response to aerosurface servo-amplifiers, electronic devices connected to each aerodynamic control surface. Deflection of these surfaces is governed by a rate feedback system.

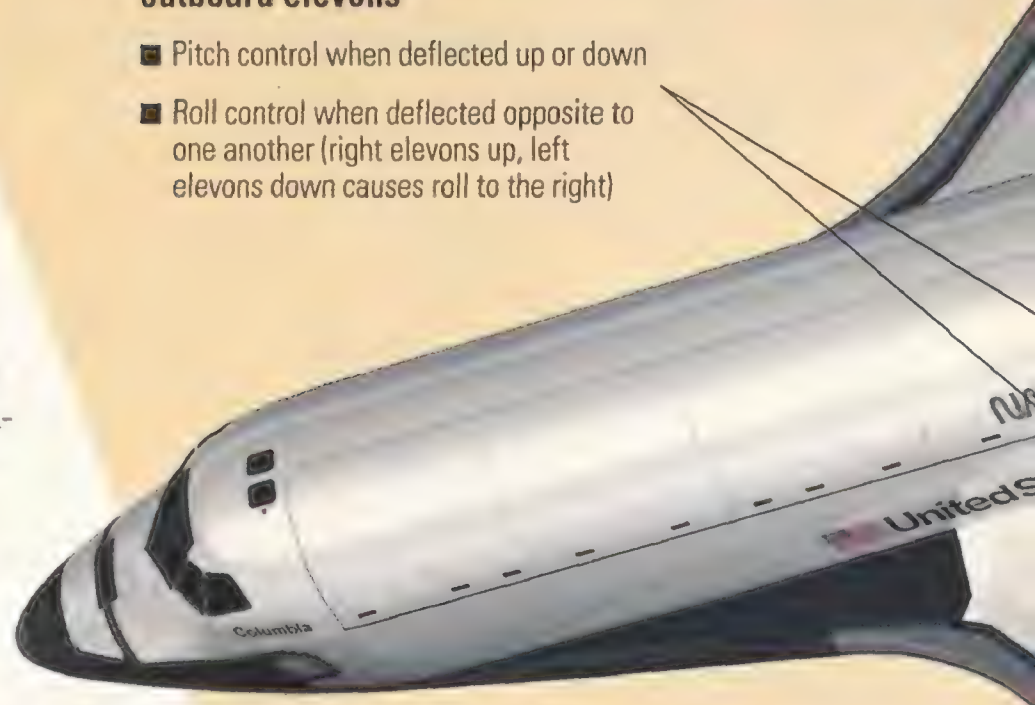
"Every time the stick is out of detent [the neutral position], it is commanding, for a given deflection of the stick, one degree per second, two degrees per second, and so on," Precourt says. He refers to the rate at which the nose will move toward where the commander wants it. "When you are on final approach, you can let go and the orbiter will stay on that path, because when you let go, you had zero degrees

Aerodynamic control surfaces

Left and right inboard and outboard elevons

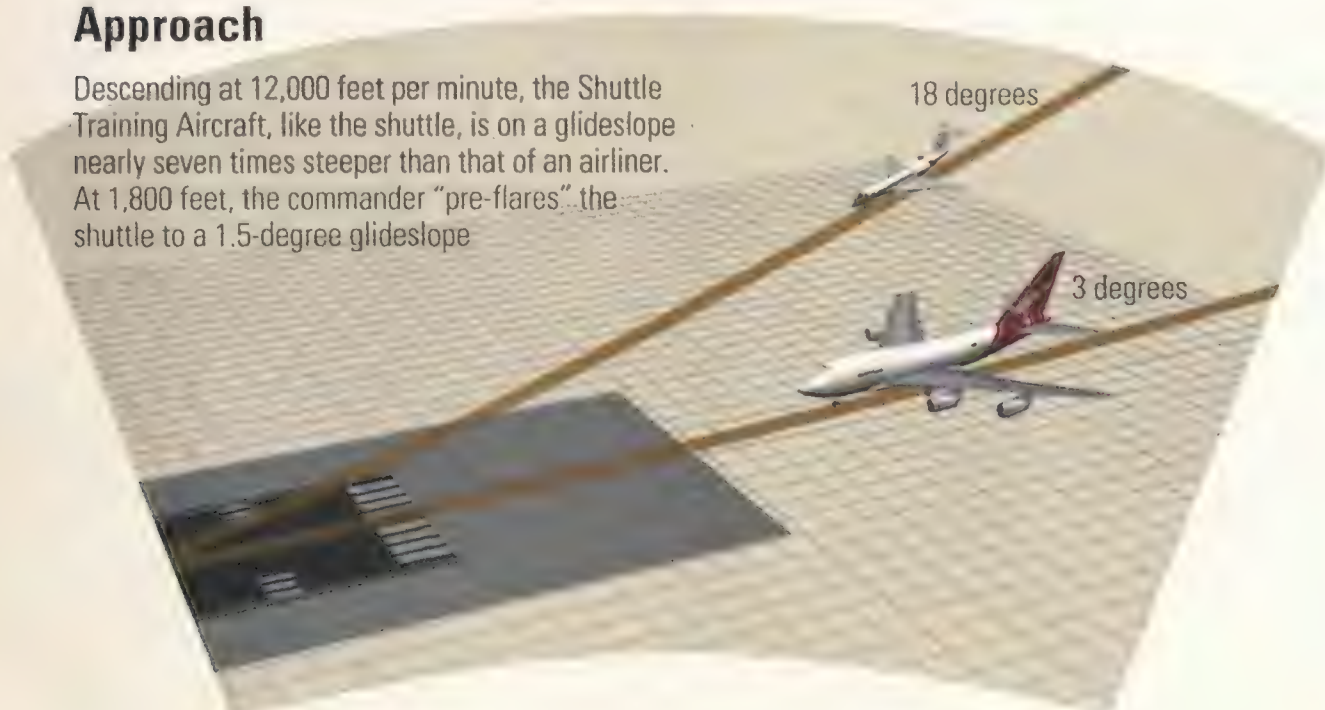
- Pitch control when deflected up or down
- Roll control when deflected opposite to one another (right elevons up, left elevons down causes roll to the right)

Right Inboard and Outboard Elevons



Approach

Descending at 12,000 feet per minute, the Shuttle Training Aircraft, like the shuttle, is on a glideslope nearly seven times steeper than that of an airliner. At 1,800 feet, the commander "pre-flares" the shuttle to a 1.5-degree glideslope



per second of change in attitude at that airspeed. That is the rate that the stick is going to command." In the shuttle, the flight control system automatically compensates for the restorative aerodynamic forces that want to move the nose back to level flight.

"In a conventional aircraft, the pilot pulls the stick back less at higher speeds than at lower speeds to get the same pitch rate—say, for a pitch rate in a loop of a constant 10 degrees per second, he has to change the amount he pulls back on the stick as the speed changes," Precourt says. "In the shuttle, the pitch rate you get is independent of the aircraft speed. The same rate results for the same deflection no matter what your speed. The benefit of this kind of system is that you don't have to be trimming off stick forces." But there is a disadvantage too.

"When you are down low, closer to the flare, and you make an input, you don't want to hold the stick back because it will over-rotate," or pitch up too much. "So," Precourt continues, "you pull the stick back at the rate you want to get a new attitude. When it ap-



Rudder/Speed Brake

- Yaw control when both panels deflected left or right
- Speed brake when both panels opened at trailing edge to increase drag

Body Flap

- Thermal protection for main engines during reentry.
- Provides trim force to reduce elevon deflections

proaches that attitude, you have to let it go. Instead of continuing to pull, you make a series of pulses. The controls take quite a bit of getting used to. That is why we train so much in the Gulfstream."

Shuttle commander Ken Cockrell describes another complication, an effect of the digital fly-by-wire control system. In this system, when the commander moves the hand controller or rudder pedals, it sends a signal to a computer, which then sends a message to move the control surface. The control surface moves, and, finally, the orbiter responds. This all takes time.

In a mechanical feedback system, the pilot relies on the immediate feedback through the control stick and rudder pedals to fly smoothly. With a computer running the show, there's a delay. "It has to figure out quite a few feedback parameters before it allows itself to make the next move, so there is a slight delay—150 milliseconds, around a tenth of a second," says Cockrell. "That is noticeable to humans. If you try to make too many inputs too quickly, you'll get way out of synch with it

and it's not so easy to fly.

"So we use the term 'open loop.' You make an input based on your experience, see if the vehicle responded the way you wanted. If it didn't, make a little more or take out some of that input. You have to build this patience factor into your hand. Once you build it in, it seems like you are flying a pretty reasonable flying vehicle. But at first people find themselves overreacting. On approach, there is a little time compression. You are a little behind.

"But *Columbia* felt just perfect to me. It sliced through the morning air as if there were not a ripple. It was a joy for me to fly. I can't wait to do it again."

Because pilots have only two minutes at the controls on each STA flight, they don't have much time to process information, but when it's the real thing, the difficulty is part of the excitement. "To land the first time you ever fly a vehicle, to land within three seconds of when you planned, on speed, with millions of people watching you, is hard," former commander Curtis Brown says. "I remember the first time I rolled out [on final approach] and I was at the stick. There is the runway and I am talking to myself. *Hey! This is the big one. This is for real.* The vehicle flies so much better than the simulator. With the STA, you get a lot of bumps. The shuttle is like a rock. Nothing fazes it."

Tonight, over the desert, the air is smooth. As the STA banks into the darkness, Jupiter chases a new moon across the pilots' windows. Nagel and Halsell agree that on a night like this, it feels like the real thing. —

"To land the first time you ever fly a vehicle, to land within three seconds of when you planned, on speed, with millions of people watching you, is hard," Curtis Brown says. "I remember the first time I rolled out [on final approach] and I was at the stick. There is the runway and I am talking to myself. *Hey! This is the big one. This is for real.* The vehicle flies so much better than the simulator. With the STA, you get a lot of bumps. The shuttle is like a rock. Nothing fazes it."

Nguyen Van Bay *and the* **Aces** from the North

by Ralph Wetterhahn

As an F-4 Phantom pilot, I had tried
to kill these men. And they had
tried to kill me. I thought it
was time we had a talk.



At 25, Nguyen Van Bay trained as a fighter pilot in MiG-17s. The first ace to be announced by the Vietnamese People's Air Force, he is credited with seven kills.

Many of my trips to Vietnam have run together in my memory, including some of the 180 I made in McDonnell F-4 Phantoms during what the Vietnamese call "the American war." But one I took in 1997 will always remain distinct. On that trip I met North Vietnamese ace Nguyen Van Bay (pronounced "win von by").

I was on a kind of mission, one that really got started seven years earlier when I went to Hanoi with state department official Ken Quinn, later the U.S. ambassador to Cambodia from 1996 to 1999. Quinn was searching for information about U.S. servicemen who were classified as missing in action, and one of them, Major John "Robbie" Robertson, was a friend of mine, a squadron mate. In 1966 we both flew F-4Cs from Ubon Royal Thai Air Base in Thailand during the Rolling Thunder bombing campaign. On a strike mission on September 16 that year, Robbie's flight was ahead of mine. He didn't return. The squadron could get very little information about his crash, and Quinn and I were hoping to find out more. There was a rumor that Robbie had survived, based mainly on a soon-to-be infamous photograph, which Quinn had brought with him, of three POWs alleged to be alive and captive in Laos.

The Vietnamese officials we talked to promised to investigate the photograph, which turned out to have been a hoax. They also eventually put me in touch with several fighter pilots from the Vietnamese People's Air Force, the air force of North Vietnam. That's how I came to be sitting across a table from two VPAF pilots in 1997: Do Huy Hoang (pronounced "doe wee wong") and Nguyen Van Bay. I was the first American pilot either of these men had ever met.

Bay is credited with seven kills. At 63, he is a small, frail-looking man with a deeply lined face. He grows mangos and raises fish for a living on a small farm near Ho Chi Minh City (formerly Saigon), the capital of the South, where he moved after the war ended. He's a heavy smoker, and I noticed as I sat down across from him the brand he was smoking was 555, the same number as my old squadron, the Triple Nickel. We regarded each other through a haze

of blue smoke. I turned on the tape recorder, thinking that we'd go through his seven claims first and then I'd see what I could find out about Robbie.

Bay read from a tattered piece of paper, which, according to the interpreter, listed all his dogfights, including seven victories. He began the description of each engagement by reading off the date, then he described the details of the air battle—the location, flying conditions, number and types of aircraft, maneuvers and counter-maneuvers, and how the fight ended. The interpreter tried his best to keep up, and as he spoke, I checked Bay's narrative against the reports I had brought with me from official U.S. records and North Vietnamese documents. It's difficult to sort out the melee of a dogfight after the fact, and I was surprised to find how well his reports correlated with the official ones.

I had been intently taking notes and checking documents for about two hours when Bay began describing incident number 6.

"Sixteen September 1966," said the interpreter.

I stopped writing and looked up. Bay also looked up from his paper, and hesitated for a moment. Then he nodded, and I could sense that he knew he was about to describe a fight already familiar to me in some way.

"I was there...almost," I said. The interpreter leaned toward Bay and spoke.

Another puff from the 555. Another nod. Then Bay read from his list the description of how he had killed Robbie.

The alarm to scramble sounded at Gia Lam airfield near Hanoi in the early afternoon. Bay flew the third position in a flight of four, led by Ho Van Quy (pronounced "ho von kee"), who had one F-4 kill to his credit. By this time, Bay had one of each: an F-4,



Retired MiG-17 ace Luu Huy Chao (right) and Dinh The Van, former commander of a surface-to-air-missile crew, stroll by a MiG-21 at the main entrance to the Air Defense Museum in Hanoi. Today Chao is a dealer in Chinese herbal medicines.

a Navy Vought F-8 Crusader, and a Republic F-105 Thunderchief. Luu Huy Chao (pronounced "loo wee chow") flew as the lead's wingman. Chao also claimed three kills at this date and eventually became an ace.

Bay was the first to spot Robbie's flight. When he asked permission to attack, Quy expressed doubt that the slower MiGs could catch the F-4s up ahead. But as the MiGs tried in vain to close the distance, Bay saw the Phantoms make a mistake. He saw them begin a climbing turn.

A few months after I met Bay, I talked to Robbie's backseater, Hubert Buchanan. They were also flying at the number 3 position in their flight. It had been Buchanan's 17th combat mission and one of the bigger strike packages he'd been part of. "We were trying to avoid radar detection," he said. "We were down kind of low, but not real low where we'd get the ground fire, and the big strike was going on. Planes all over the place. And somewhere between Haiphong and Hanoi, I guess more toward Hanoi, one of our flight members yelled that there were MiGs, six o'clock low.

"At that point, everything, all the ordnance and fuel tanks we had, everybody dropped those and then went into combat trail and began a climbing left turn...which is not a good plan. The MiGs began to cut off our flight in the turn and climb also."

Bay had all three of his guns armed by this time. "I rolled in behind the Phantom," he said. "Our gunsight was poor. What I had to do was close to within 100 to 150 meters and begin firing. I would make adjustments from watching the tracers."

Buchanan remembered telling Robertson, "This guy's pulling right in on us. He's going to shoot any time now!"

At that moment, a salvo of orange golf-ball-size rounds flashed over Buchanan's canopy. Robertson pulled hard, then eased his turn. Buchanan saw the MiG closing again. He said, "This is going to be it. He's corrected the problem."

Bay lined up, fired again, and saw a wheel come out from beneath the F-4's wing and sail past his canopy. For Buchanan, everything went black. "It could be from so many G-forces pulling the blood away from my eyes, not sure," he said. "My helmet is bouncing around. I don't really have a clear memory of ejecting; however, I do sort of have

like a dream. I can kind of imagine pulling the handle the F-4 had between your legs. I also ejected, so I must have done it. I could hear booms, like the canopy blowing off. And I felt wind. The next thing I knew, my parachute was opening.

"When I got down low, I could see people running around on the ground in a little village. I could see a guy off to the right, looked like he had a uniform on and a rifle, running in my direction."

Buchanan was captured and remained a prisoner until 1973.

Bay sped away from the burning Phantom, then rolled back to look. He watched the aircraft pitch down in flames. "I saw one chute," he said.

Of the 16 VPAF pilots who have claimed ace status, only three, including Bay and Luu Huy Chao, flew MiG-17s. The other 13 flew the later model MiG-21, a delta-wing aircraft equipped with radar and heat-seeking missiles and considered the equal of the F-4 and F-8 in maneuverability and acceleration. The 1950s-vintage MiG-17 was difficult to control in roll and pitch at high speeds. It had no radar and no missiles. It was armed with one 37-mm. and two 23-mm. cannon, and its lead-computing gunsight had no

radar for ranging; that's why Bay had to watch his tracers and adjust his aim accordingly. The MiG-17's advantages were its good visibility and superb turn rate, but these aircraft were heavily outnumbered by the more modern U.S. Phantoms, Crusaders, and Thunderchiefs.

The Americans claimed 103 MiG-17s and -21s between June 17, 1965, and January 12, 1973. For a MiG pilot to survive nearly eight years of war was an achievement in itself. Becoming an ace in the process made him a national hero. As I talked to Bay, and later to MiG-17 ace Luu Huy Chao, about the conditions of their training and their combat experiences, my understanding of their particular kind of courage grew.

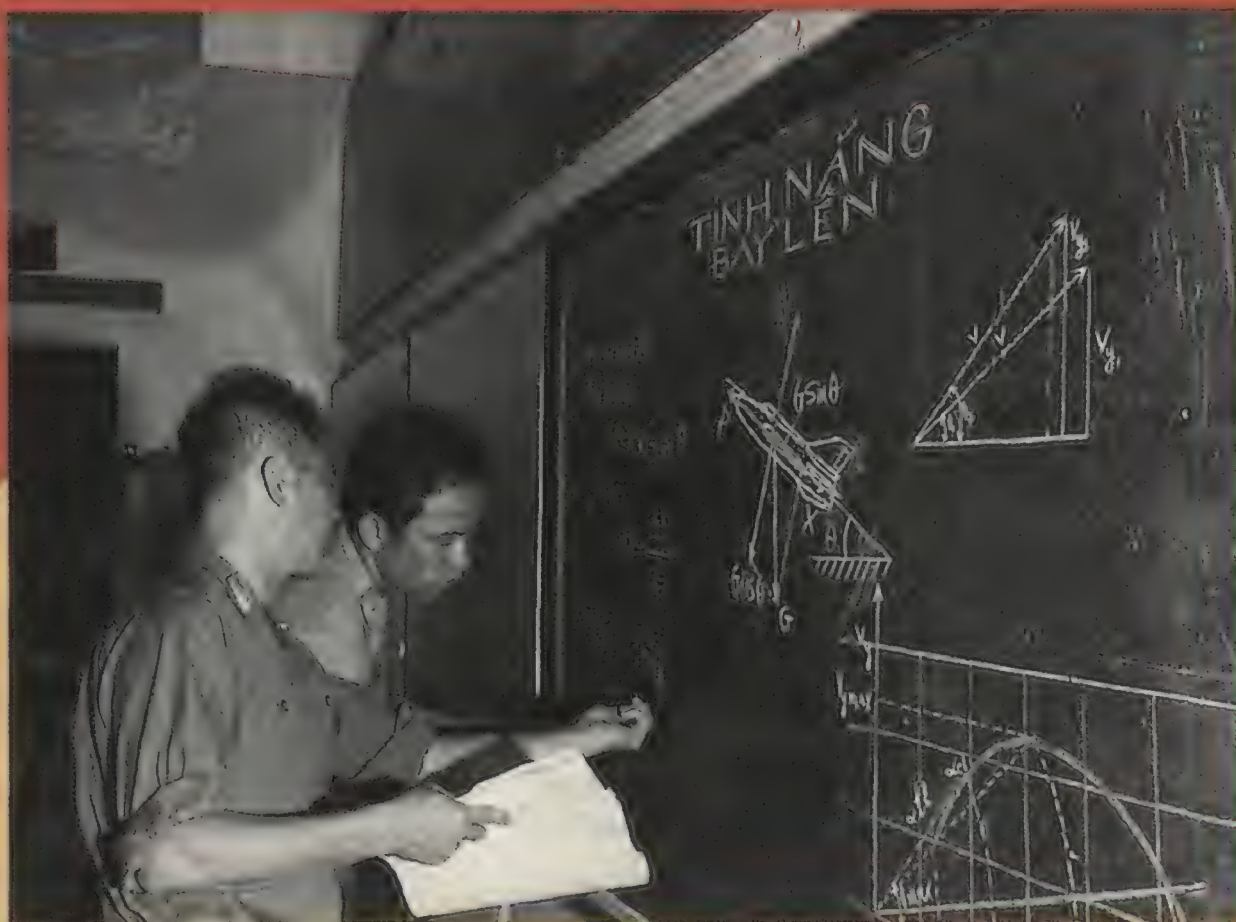
Bay was born in 1937 near Saigon, the seventh of 11 children. He went north at 16 to join the army and fight against the French, and when that war ended in July 1954 with the peace agreement that partitioned the country, he chose to stay north. He had by this time lost contact with his family.

He volunteered for flight training in 1962 and was among the first pilots sent to China to learn to fly fighters. As he told it, he "went from the bicycle to the airplane with no

During "the American war," VPAF pilots were often rallied by Ho Chi Minh, whose statue at Hanoi's VPAF museum is near another symbol of support: a Soviet Mi-6, used to transport MiGs from targeted airfields to remote shelters. VPAF pilots in the 1960s (right) learned the MiG-21's optimum takeoff and climb angles.



GEOFFREY CLIFFORD



VIETNAM NEWS SERVICE



COURTESY DO HUY HOANG

Do Huy Hoang, who sometimes flew as Bay's wingman, was shot down twice during the war. Today he pilots a motorbike in his Ho Chi Minh City neighborhood.

stop in between." He learned to drive a car only long after he began flight training.

The trainees started with Yak-18s, moved on to MiG-15s, and finally flew MiG-17s. "It took four years to train, all of it in China," Bay said. "We had Russian instructors." Other trainees, including Do Huy Hoang, who joined up the same time Bay did and went with him to China, followed the first year of training in China with two years in Russia. Like U.S. pilots, the North Vietnamese typically flew 200 hours in training before going into combat. Bay, Chao, and Hoang got about a hundred of those hours in the MiG-17.

Getting his wings did not come easily for Bay. "I got sick all the time during the early part of my training," he said, "so I cut off the top half of a soccer ball, tied it with a string, and wore it around my neck when I flew. Whenever I had to vomit, I filled the soccer ball."

Bay was still in training in 1964, the year the North first came under attack by U.S. aircraft. On August 5, two U.S. aircraft carriers launched strikes against coastal targets, so-called reprisals for a North Vietnamese torpedo attack on a U.S.



GEOFFREY CLIFFORD

destroyer gathering signals intelligence in the Gulf of Tonkin. The VPAF had just received a gift of 36 MiG-17 fighters and MiG-15UTI trainers from the Soviet Union, but strategists feared squandering aircraft and pilots against the U.S. strikes. They sat tight and sought more recruits for flight training. The following year, Bay was back home, U.S. aircraft had initiated the sustained bombing campaign Rolling Thunder, and the VPAF was ready to send MiGs to attack them. From April through December 1965, VPAF aircraft challenged U.S. fighters in 156 dogfights and claimed 15 victories.

Bay's first engagement came on October 6, 1965. He was attacked by an F-4, almost certainly that of U.S. Navy pilot Dan McIntyre and Radar Intercept Officer Alan Johnson, who reported firing an AIM-7D missile at a MiG-17 and claimed a "probable." Bay remembered a missile detonating off his left wing. "I felt the heat from the explosion," he said. "The aircraft pitched down and began vibrating." He immediately turned toward Noi Bai airfield, just north of Hanoi, and nursed the airplane to a safe landing. On the ground, he counted 82 holes in his aircraft.

"I felt like a light boxer who



Nguyen Van Bay returns in triumph after one of his seven victories. Below: In a formal military ceremony held in December 1966, Bay (at right) and his squadron commander Lam Van Lich (at left) were awarded the Golden Star, Hero of the Vietnamese People's Armed Forces.



NGUYEN VAN BAY COLLECTION (2)

confidently walked up to the ring and tried to knock out the super heavy boxers," Bay said. "It was not a single fight but dozens of dogfights. We were outnumbered four or five to one. Our thoughts were on survival, nothing more."

Luu Huy Chao remembered that F-4s dominated his thoughts in training. Chao, 67, lives in retirement in Hanoi, where I spoke with him in 1998. Like Bay, he had also fought the French and learned to fly an airplane before he learned to drive a car. "Our training included a lot of discussion about fighting the F-4," he remembered, "which was considered

the gravest threat due to its advanced features."

"The American fighters flew faster than ours," said Bay. "We had to force them to turn. When they turned, the speed did not matter. We could change the center of the [circle] and cut the diameter to chase the enemy. We just made use of an appropriate angle to cut their [circle] and our guns became effective."

Bay's guns first became effective in late April 1966. When the radar network indicated that U.S. aircraft were approaching Bac Son and Dinh Ca, districts near the coast where a strike package was heading, an

officer scrambled four MiG-17s to meet them: Bay, Chao, and Tran Triem followed Ho Van Quy's lead. Shortly after takeoff, Bay spotted eight F-4s. One of them swung wide as the formation turned. Bay cut him off and closed to firing range. "When I saw the whole F-4 in my windscreen, I fired," he said, "and the F-4 went down." He wrote to his new bride, an accounting student at the university in Hanoi, that this was "the first U.S. aircraft I shot down."

Bay had been married just over a week, he remembered. The wedding had taken 15 minutes. "I took off my flightsuit, put on civilian clothes, had the ceremony, and had time for one cigarette," said Bay. "Then I got back in my flightsuit and went back on alert. I flew combat for 12 straight days before I saw her again."

Chao recalled that the pilots sometimes slept under the wings of their aircraft when they were on alert. "On a typical day, we were at the planes by 8 or 8:30 a.m. and got ready to scramble," he said. "Sometimes the scramble order came by shooting a flare. Other times, a bell was used."

"The bells were made from U.S. bomb casings that had the explosives removed. The bell was hung from a tree and a hammer was used to sound the alarm for scramble."

By the summer of 1966, U.S. forces were launching regular strikes against Hanoi, Haiphong Harbor, and other military and industrial centers in the north, and MiG-21s had joined the fight. Bay shot down another aircraft, an F-105, in June and remembered what he and his comrades were thinking as the waves of U.S. aircraft kept coming: "The Americans are well-equipped. Their planes are more modern and bigger in number. We all know their strength. Their weakness is to fly from far away. All of them feel thousands of eyes looking up at them and thousands of guns shooting them from the ground. Their eyes cannot concentrate 100 percent on our planes; therefore we usually discover them before they [discover us]."

When I met Bay again years later, he elaborated on his strategy. "The

most important thing was to discover the enemy first," he said, "to gain higher speed and height, to get better position. We learned a lot of lessons and studied many famous dogfights from World War II between the Soviets and the Germans, and also the dogfights in the Pacific with propeller planes and guns. Whoever fires first, wins."

VPAF pilots got help seeing their attackers by Ground Control Intercept (GCI) radar installations located on the outskirts of Hanoi and close to the coast near Haiphong. The radar showed a picture of the unfolding air battles to ground control officers, who managed the intercept missions from a primary radar van in Hanoi. Ground control officers ordered the scrambles, kept the surface-to-air missiles, or SAMs, from firing on VPAF aircraft, and made the final decision on whether to commit aircraft to an attack. They were helpful but fallible. Bay remembered returning to Kep airfield in a flight of four when he saw a SAM coming toward them. "We thought it was going to protect us from American fighters who were reported behind us," said Bay. "The missile exploded right in front of the

lead MiG. The pilot ejected."

On September 5, 1966, the senior ground control officer was a former MiG-17 pilot, Le Thanh Chon (pronounced "lay tan chon"). He vectored Bay and his wingman Vo Van Man out of Gia Lam airfield at around 4 p.m. toward an unknown target to the south. As Bay headed due south, he glimpsed a flight of A-4 attack jets heading away from a smoking bridge. Directly in front of him, he spotted two F-8s approaching the A-4s from the right of a large cumulus cloud toward which Bay and Man were headed. The MiGs jettisoned their drop tanks in preparation for battle. "[The F-8s] rolled toward the A-4s and took up position behind them to escort them from the target area," he said. The whole package began moving around the left side of the cloud mass. Chon saw all this happening on the GCI radar, ordered Bay to continue straight ahead, skirting the right side of the cloud, and gave Bay permission to engage. Bay attacked the trailing F-8. "I made two firing passes, the second from 80 to 100 meters away," Bay recalled. "I watched my tracers and adjusted my aim. The rounds hit the Crusader

near the canopy. The plane started coming apart. Pieces came flying back at me." Bay pulled away and was maneuvering for a third pass when he saw the F-8 pilot eject and the airplane crash. The engagement had lasted 45 seconds. When Bay landed, the maintenance crew found pieces of Plexiglas in his engine inlet. He later learned, he said, that the F-8 pilot was captured. (U.S. Navy records report that on September 5, 1966, Wilfred Keese Abbott was shot down over North Vietnam while flying an F-8 Crusader at the exact location cited by Bay. Abbott was captured and survived the war.)

Although the GCI radar had given Bay the advantage in this engagement, a few weeks later, on September 21, the GCI failed him. Directed by the ground control officer to a target 10 miles ahead of the four-ship flight he was leading, Bay, after about seven minutes, saw two F-105s at around 10,000 to 13,000 feet. He banked in pursuit, then eased out of the turn behind one of the pair but was still well out of shooting range. Knowing that the Thunderchiefs usually traveled in packs of four, Bay scanned the sky for the others. Usually they were

MiG-17 pilot Ho Van Quy with his wife of 35 years (right) and on the flightline (below, far left) at a northern airfield in 1969. Quy flew lead on many four-ship missions.





With their MiG-17s in the background, VPAF pilots, congregating near a sign urging them to shoot down more U.S. aircraft, read a rallying statement from Ho Chi Minh, urging them to do the same.



A new generation of Vietnamese congregate near the MiGs now on static display at the VPAF museum.

easy to spot—at the end of long black smoke trails that spewed from their engines. Their dark green and brown camouflage, difficult to see against a jungle background, stood out sharply against blue sky. But Bay saw nothing. Satisfied, he gave his wingman, Do Huy Hoang, permission to attack one of the two Thuds.

American pilots, who flew without the benefit of ground radar, tended

to stay together in what they called the “welded wing”—a defensive position requiring a wingman to stay close to the leader in order to provide visual cover of the rear of the formation, while the lead concentrated on what was ahead and did the shooting. However, the tactic of splitting the wingmen to operate separately was an accepted procedure for the VPAF.

Hoang spread wide to the left, lined up behind the second F-105, and, with Bay, waited for the targets to turn. The two Thuds ahead rolled into a shallow bank.

“We were ambushed,” Bay said.

Flying low—too low to be picked up by the GCI radar—and well behind the lead F-105 element were First Lieutenant Karl Richter and Captain Ralph J. Beardsley. As the lead element maneuvered in search of SAM sites to attack, Richter and his wingman stayed low, preparing to follow them to the target. Then Richter saw the MiGs. He later wrote in the November 1967 issue of *Airman* magazine, “They slid in front of us beautifully—about a mile and a half or two out. It was funny. We have so few contacts [with MiGs], it takes probably a full second before it jogs your mind.... Those are not airplanes like any we fly.”

Richter jettisoned his rocket pods, armed his M-61 Gatling gun, and lined up on the left MiG. “He made an easy turn,” Richter wrote. “I moved the pippa [aiming device] out in front of him and started firing.”

Richter kept firing 20-mm. rounds at the rate of 100 per second. “I thought *Boy, this is going to be embarrassing if you miss this guy*, then Beardsley called, ‘You’re hitting him! You’re hitting him!’” Richter saw fire coming out of the back end of the MiG, “but he still seemed to be moving through the sky pretty good.”

Hoang heard a thump. The airplane rolled on its own to wings level. Alarmed, he lit the afterburner as the airplane continued rolling right while he tried to regain control. The aircraft responded, but something was wrong. Hoang glanced around and saw that the outer portion of his left wing was in tatters. “I was still flying though, so I just concentrated on staying under control.”

Richter fired again.

Hoang had just finished checking his engine instruments. The VK-1A turbojet was running fine. “I thought I was going to be okay, when all of a sudden the plane started to come apart.” The instrument panel shattered. Hoang felt pain in his side

and back. He reached between his legs for the ejection handle.

Just as Richter ran out of ammunition, the MiG's right wing broke off. Pieces flew off the tail and another big chunk flew loose from the airplane. As Richter pulled up to avoid the debris, he saw the MiG pilot eject and heard Beardsley announce, "He's got a good chute." The two Thuds departed at high speed.

Good chute or not, Hoang's troubles were far from over. VPAF pilots carried their national flag in the back of their parachute harness to use after ejection. The idea was to wave the flag as they descended in the parachute to alert the ground forces that they were friendly pilots. More than one North Vietnamese pilot had been accidentally fired upon by his own countrymen.

"I was bleeding from shrapnel in my side and back, and my arm was broken," says Hoang. "I couldn't reach behind for the flag."

Meanwhile a flight of F-4s entered the fray. Alone, Bay evaded one missile after another. He used hard turns to defeat the attackers, but the maneuvers were costing altitude and fuel. "I could avoid the missiles," he said, "but was in a very serious situation. Fuel nearly finished. At first I intended to eject, but when I dropped lower I suddenly saw the Americans flying away. Then I saw [Vo Van] Man in front of me. I followed Man [and landed safely]."

Hoang came down in a rice paddy. When he shouted that he was on their side, the local villagers heard his southern accent and thought he was a South Vietnamese pilot, even more hated than the Americans. "They stripped off my flightsuit and tied my hands behind my back," Hoang says. "One farmer began beating me until the soldiers made him stop."

Hoang was in no shape to walk, so the soldiers put him on a two-wheel buffalo cart to be pulled into town. It took an hour for his captors to verify his identity. Once they had done so, they quickly untied him and rushed him to the hospital. After recovering from his injuries, Hoang began flying



Nguyen Van Bay lives near Ho Chi Minh City on land his family owned before the war. He grows mangos and raises fish for sale to the local market.

a MiG-21 and was shot down again on September 29, 1967.

Hoang's left arm and throat still show the scars from Richter's attack. Richter was killed 10 months later.

In the first four months of 1967, Bay claimed three more U.S. airplanes. His victories made headlines. He had become famous. A favorite of Ho Chi Minh, he dined regularly with the leader and was grounded, at first sporadically and then permanently, for no reason other than to protect his value as a symbol of triumph.

In 1990 Hubert Buchanan went back to Vietnam to visit the village where he landed after ejecting from his stricken F-4. "I found the guy who got the award for capturing me," he told me. "I found the guy in the uniform, who I'd seen off in the distance running toward me. He said he was so frustrated. They only had two rifles in the village and he knew he would never get there first."

At one point in our conversation, Buchanan said out of the blue, "If we had accelerated straight ahead, they would never have gotten us. It was only after we started to turn were they able to cut us off. Otherwise

we'd have left them in the dust."

Robbie's daughter Deborah Robertson Bardsley tried for years to find her dad—her quest was the subject of a 1993 Discovery Channel documentary. According to the U.S. Army Central Identification Laboratory at Hickam Air Force Base, Hawaii, fragments of remains discovered at the crash site in 1992 and again in 1997 have not been confirmed as those of John Robertson but provide strong circumstantial evidence that he died in the crash. I believe that is the case and told Bay so when I visited his home recently. I think he was hoping, as I was, that the family had finally been able to say goodbye. During my visit, his wife said of him, "He is a hero in my opinion because the people still come to see him."

Later at a nearby restaurant, Bay and I behaved like all good fighter pilots, challenging each other to drinking games. It grew late, our driver got antsy, and finally Bay stood. Our crowd got up and headed for the car. When the driver pulled to a stop on the main road near the lane to Bay's farm, Bay hopped out and I followed. He gave me a bear hug, smiled, and headed home. —

Can We Talk? (Well, no, actually...) | by

U.S. firms may break the law by merely sharing information with a foreign partner. Are such controls worth their cost?

If you want to hit a nerve in your next conversation with an aerospace executive, try these two words: “export controls.” Politicians extol the benefits of a global economy, but it can take months or years for a U.S. company to get permission from the Department of State to talk about an aerospace project with a foreign partner. And some firms are paying serious money in fines for export violations. Boeing was fined \$10 million by the state department’s Office of Defense Trade Controls for unauthorized technical discussions with Ukrainian partners in its Sea Launch project. Last summer Lockheed Martin was docked \$13 million by the ODTC for a 1994 conversation with China’s Great Wall Industries Corporation.

The problem started back in the mid-1990s, when the U.S. firms Hughes Electronics and Loral Space and Communications helped Great Wall figure out why its Long March rockets were blowing up, costing Hughes and Loral lost payloads. The trouble was, under the U.S. Export Control Act, it’s a crime to pass information on rocket design to foreigners without permission from the federal government, so the Department of Defense requested an investigation. Hughes and Loral believed the information they provided to Great Wall was not sensitive, so neither tried to hide its assistance. On the contrary, the companies wanted as much press as they could get in order to boost the confidence of the insurers underwriting the Long March.

The investigation put export controls—usually an issue exciting only to lawyers—smack in the middle of partisan politics. Republicans in Congress accused the White House of greasing

the wheels for U.S. aerospace companies seeking export licenses that allowed them to use low-cost foreign launch vehicles. (Loral’s chairman, Bernard L. Schwartz, happened to be one of the Democrats’ leading individual contributors.) Republicans called for an investigation; Democrats ducked for cover. Soon every venture with a foreign partner was under a cloud. Bureaucrats began to enforce the law more strictly than ever, and elected officials were afraid to intervene for fear of being seen as soft on security.

Meanwhile, U.S. companies are losing sales abroad. Prospective customers fear that they may be buying a criminal prosecution as part of the deal. Even our NATO allies have become reluctant to work with U.S. contractors. At the same time, the reputations of some aerospace companies are taking a slow burn over reports about “lax security” and “illegal technology transfer.” Most of them have devoted their careers to designing aircraft, rockets, and satellites to defend their country.

How did we get into this mess?

Odd as it may seem, controls on technology export are a recent development. Before World War II, the U.S. government might regulate foreign weapon sales so that one couldn’t pack up a tank or a Gatling gun and ship it to Paraguay. And the government often clamped down on sensitive information during wartime. But there were virtually no controls on transferring technical information abroad during peacetime.

Then came the cold war. U.S. officials worried about losing the technical edge over the Soviet Union, so in



DAVID POVILAITIS

1949 the United States and some of its allies created the Coordinating Committee for Multilateral Export Controls, or COCOM. The members agreed to identify sensitive military technologies—called the Munitions List—and require government approval for companies to share them with foreigners, lest they wind up in Soviet hands.

This was a big change. Now it was not just the hardware itself that was controlled, it was *information* about the hardware. Before you could have any substantive technical discussion with a foreign engineer about any technology on the Munitions List, you needed a “technology assistance agreement” from the ODTC.

Such regulations might have worked 50 years ago, when the United States dominated fields like electronics and aerospace and most technologies with military applications came out of government labs or companies with military contracts. Under those conditions, the U.S. government had a good chance of identifying sensitive technologies and controlling them.

Ironically, much of the work of controlling technology was done for us by

entary

Bruce Berkowitz

the Soviet Union. It wasn't as if you could just walk into the Korolev Design Bureau and chat up a few engineers. They couldn't travel here, we didn't travel there, and there were few sales across the Iron Curtain. This made it easier to spot and interdict the odd attempt to smuggle an IBM 360 across the border.

Today the situation is completely different. The Soviet Union no longer exists, and we live in a global economy. But instead of scrapping technology controls, the United States has tried to reformulate COCOM into a wide-ranging, international system of controls with the aim of regulating the flow of dual-use technologies—that is, commercial technologies that could be used for military purposes.

Such efforts are doomed to fail. Too many people travel, too many people communicate, and too many goods get shipped between nations for such complex controls to be effective. Also, the United States no longer enjoys the kind of global dominance in high-tech fields that it once had (look at Europe's cell phones). At home, the commercial sector is often ahead of the government (look at Silicon Valley). As a result, it is impossible for the U.S. government to control technology—at least not without isolating ourselves from our trade partners and the world's scientific community.

When you read the investigation reports and learn exactly what it was that Hughes and Loral told Great Wall, you can begin to appreciate how absurd technology controls can be. Defense department investigators found that Hughes engineers helped the Chinese in at least two areas: modeling launch stresses and designing the rocket's payload fairing, or nose cone. (Hughes' recommendation to Great Wall: Don't skimp on the screws.) For its part, Loral advised the Chinese in basic quality control procedures. According to

the defense department's report, Great Wall gave Loral the design of its Long March inertial measurement unit (the electronic gyro that tells a rocket its attitude, direction, and velocity). The Loral engineers studied the design and identified two deficiencies: poor electrical connections and a wiring harness layout that could chafe under launch loads.

In other words, we got the detailed design of the guidance system for an operational Chinese missile; they learned how to solder an electrical connection. It makes you wonder which way the technology was really transferring. Perhaps the Chinese government should have done its own investigation.

Maybe the information imparted by

"If you put two engineers
in a room together, before
you know it, technology
transfer occurs."

Hughes and Loral helped the Chinese build better missiles; maybe not. One of the most outrageous things about technology controls is that you can be guilty without anyone's having to prove any damage. As a mid-level export control official once told me, "If you put two engineers in a room together, before you know it, technology transfer occurs." The conversation constitutes the violation.

But all of this misses the point. If the Chinese really wanted the information they supposedly obtained from Hughes or Loral, they could have gotten it without the help of the two companies—and, for the most part, legally. The technology the Chinese obtained

is routine stuff for U.S. aerospace engineers, and mainly unclassified. The Chinese could have learned a lot just by ordering the right military specifications, or "milspecs," from the U.S. government. They're even on the Internet (try www.dscc.dla.mil, for one).

Our current export policy implies that interaction with foreigners is so dangerous that the government must approve and monitor any contact between our engineers and theirs. If that sounds familiar, it should. It's how the Soviets used to run their economy. And we know how that turned out.

Of course there are some highly specialized technologies that really are sensitive and need to be protected. That's why the government classifies information like the composition of stealth aircraft materials and the subtleties of nuclear weapons designs. Transfer of this kind of technology is called espionage, and there are laws to deal with it.

The difference is that only a select group of people—not the entire aerospace and electronics industries—have access to classified data, and it's kept under lock and key. It's usually specific information that we can protect, and we are willing to accept the cost and inconvenience of doing so. In comparison, almost anyone in a developed country—and even in the developing world—can gain access to "controlled dual-use technologies." The information really is not controlled at all.

Our current technology transfer controls violate the two most important rules of security. First, before you try to restrict information, make sure you can. And second, be sure you are prepared for the costs. They're usually greater than you think.

Bruce Berkowitz is a research fellow at the Hoover Institution. He writes frequently about national security issues and technology policy.

jet

Cet

BY JOHN CROSSMAN

INSIDE THE SECRETIVE
BIZJET TRADE.



When he wants to have some fun with visitors, Dan Dickinson will welcome them into his office and suggest they shut the door. They search. He smiles. There is no door. "We're a very open company. We want everyone to hear what everyone else is doing," says the founder and president of General Aviation Services, Inc.

However, that openness generally extends only as far as the company's walls: Dickinson and his dozen or so employees traffic in some of the most valuable and least public manufactured assets on the planet—private jets—and discretion always takes precedent. Mindful of personal safety, and, in the case of businesses, corporate espionage and the possible ire of stockholders, most owners of private jets fly as anonymously as possible, the plain white exteriors of

their aircraft providing scant hint of the polished wood, leather seats, fine china, and in some cases the private bedroom, exercise room, and shower within.

A similar veil of secrecy and inscrutability surrounds the multibillion-dollar business of buying, selling, and—especially in Dickinson's business—re-selling these coveted assets. The manufacturers who produce the new generations of faster, roomier flying offices are responsible for innovation and price benchmarks. But in truth, they're the tail that wags the dog. For in a given year, previously owned airplanes account for about eight of 10 private jet sales. It is here, in agreements struck while cruising at 40,000 feet or on cellular phones or in a blizzard of faxes, when sales commissions often reach six figures, that the deal-making gets not only intense and somewhat Byzantine, but

often a bit sketchy. "You have to understand," says one industry insider with nearly 20 years in used aircraft sales, "there's a lot of money in this business, and the more confusing it becomes, the better it is for the people who are prepared to play, you know, a shell game. There's probably nobody better, even on Broadway and 34th Street."

That kind of behavior—which includes secret commissions, fudged logbooks, and the like—held the industry back for a number of years, admits Dickinson, a founding member and former president of the National Aircraft Resale Association, which debuted in 1990 largely to help curb such abuses. Though the problems are not quite eradicated, the profession has cleaned its act up considerably. It's a good thing too, because a host of factors have set the corporate jet business booming. High among them are the changing

DAVID NANCE (3)



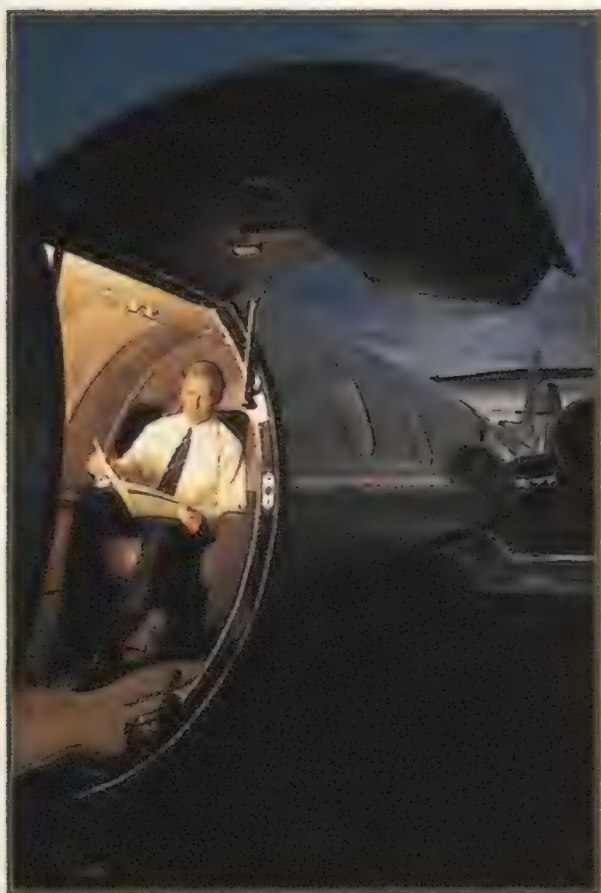
China and crystal in the cabin and a sumptuous buffet: The stage was set for sales at an invitation-only marketing event hosted by Bombardier last May at Houston's Hobby Airport.



business climate and changing attitudes. For years, as corporate jets touched down in Palm Beach and Aspen and in Super Bowl cities a day before kickoff, you could almost see the implied wink between the words "business" and "jet." Stockholders sometimes objected to what seemed like extravagant CEO perks. Hardly anybody's winking or complaining anymore. No less a barometer of business acumen than noted investor Warren Buffet embodied this shift in attitude when he changed the name of his private airplane, a Bombardier Challenger, from *The Indefensible* to *The Indispensable*.

By the mid- to late 1990s, with more and more local companies going national and more national companies going international, a private jet, or two or three, had become an essential corporate tool. It was also much easier to justify, especially when comparing the costs for a \$10 million CEO to fly the company airplane versus the cost in time and wear and tear for him to take a commercial flight. In fact, Peter Augur Jr., president of The VanAllen Group, Inc., an aviation

The pitch: Jet ownership has gone from a hard-to-defend luxury to a corporate necessity, reducing travel costs and employee fatigue.



PAUL BOWEN

consultant to Fortune 500 companies, calculated in the magazine *Business & Commercial Aviation* last fall that today's top executive might gain "the equivalent of two-and-a-half to three weeks" a year by switching from commercial flights to a corporate jet.

It's little wonder both the traffic of and traffic in corporate jets have soared equally high. At New Jersey's Teterboro Airport near Manhattan, corporate jet landings and takeoffs doubled in the 1990s, increasing from 50,874 operations in 1990 to 103,000 in 1999. There's also the effect of fractional ownership, which allows companies to own a share of a private jet as small as 1/16th and the corresponding flying time—an industry change that's akin to the advent of the personal computer. Fractional ownership—pioneered by a company called Executive Jet Aviation in 1987—has opened the skies to hundreds of companies and individuals that might never have considered operating an airplane. At last count EJA had 480 jets back-ordered from five manufacturers. "Every month we take six to eight new aircraft," says EJA senior vice president Kevin Russell. Combined, the fractional companies commandeer about 15 percent of the deliveries of new aircraft, another reason the demand has soared well past the manufacturers' ability to supply them.

Looking at new Lear's? The shortest backlog is nine months for a \$6.5 million entry-level model Lear 31. Sights set on the hot Citation Excel, the first light business jet with a standup cabin? "We're north of two years' wait time right now," says Cessna vice president of marketing Philip Michel. Moreover, industry-wide backlogs on new-aircraft orders have had a corresponding salutary effect on the market for used jets. A Gulfstream II that sold in the 1980s for \$4 million might easily sell today—a handful of owners and 10,000 hours later—for \$6 million.

Dickinson, who has been selling airplanes for 30 of his 50 years, began with transactions considerably smaller than that. He brokered his

first airplane sale while studying music in college, netting \$200 on a Cessna 172 sale. Well over six feet tall and taut as a fuselage, Dickinson has a lot of boy left in his face—and in his daily outlook. Like many people in love with their professions, he claims not to have worked a day in his life—though his "non" workday typically exceeds 12 hours.

The Chamber of Commerce stickers on the window by the entry door to General Aviation Services, which is located in a low-to-the-ground industrial park on the outskirts of the un-bustling town of Lake Zurich, Illinois, northwest of Chicago, provide little hint that inside, the phone calls are as likely to come from South Africa or Indonesia as from South Bend or St. Louis. "Most of the planes we buy we bring in from overseas," says Dickinson, explaining that 25 years ago he began establishing, rather like a baseball team with scouts in Puerto Rico, overseas partnerships and agents to gain better access to used jets off the radar of his American competition. Since then his operation has grown to six businesses, including an aircraft leasing firm and an airplane parts company. In addition to serving as a broker—selling and buying jets for corporations and individuals on commission—General Aviation, like some of the other big players, functions as a dealer, holding jets in inventory until they're sold. Brokered transactions remain the core business, though, accounting for the largest portion of the company's \$70 million in annual revenues.

Although Dickinson, who himself is type-rated in six aircraft, says that his company will sell about 50 airplanes this year, that number represents only a portion of those that his company will pursue. In some, they will actually lose money. A framed photo of a Beech King Air 300 in the conference room, for example, provides a constant reminder of the volatility of the business. "We paid for the airplane," says Dickinson, "and the next day Saddam Hussein did his trick in Kuwait and the market stopped." He starts to name a dollar amount, then

reconsiders. "We lost a significant amount of money on that plane."

Though business is booming, replacing revenues from lost sales such as that isn't necessarily easy: Private jets, new or used, do not—and probably never will—just show up on doorsteps. Ivy League colleges in pursuit of straight-A students with near-perfect SAT scores have nothing on the dogged marketing efforts of both brokers and the private jet manufacturers themselves. "This is a rifle-shot business when it comes to sales," says Learjet spokesman David Franson, explaining that FAA records provide the primary target: namely, the 10,000 worldwide owners of private jets, nearly three-fourths of which are hangared in the United States. Reading the financial pages and business magazines for skyrocketing dot-com companies provides additional leads. "The people who buy jet aircraft are fairly easy to identify, simply because of the cost of the asset," says Dana Arnold, a Texas-based regional vice president of sales for Bombardier Aerospace, builders of the Global Express, Challenger, and, since 1990, several models of Learjets.

"Everybody has their own rules. Mine are: \$50 million in gross sales for a corporation, and for individuals, a net worth of \$25 million."

This May, all such prospects within 200 miles of Houston received invitations to a static display at Hobby Airport of Bombardier's family of \$6 million to \$40 million corporate jets. Also available for walk-through: a wingless, flatbed-mounted cabin mockup of the company's upcoming Continental design, an eight-passenger, "super mid-size" jet that will sell for \$15 million. Bombardier, which first hosted such a nose-to-nose huddle of corporate jets in 1998 in San Diego for Super Bowl jet-ins, will this year showcase its fleet at a half-dozen similar events, with as many as two dozen displays to attract customers for the company's Flexjet fractional ownership program. Tours of the cabins, decked out down to candy dishes filled with spherical



PAUL BOWEN



DAVID NANCE (2)

A Falcon 900 for sale might attract dozens of eager brokers (top). At Bombardier's display, final checks are of the cosmetic variety (above), and comforts abound (right).

chocolates wrapped in Earth-patterned foil, begin with welcoming handshakes inside a hospitality tent. Amid the potted plants and the breakfast-through-luncheon buffet sits a Bombardier support team, laptops ready to match a customer's flight requirements with the range and speed and landing performance of its various jets. All of the sellers wear suits. Some of the buyers come in shorts and golf shirts.

To date, such elaborate show-and-tells remain the industry exception. Most manufacturers simply but methodically work the phones, a process that starts with researchers relentlessly cold calling to dig up leads for salesmen, who then call prospects, mail glossy brochures, and call again. Or fax. Or keep a foot in the door via e-mail. Sure as the sun



rises, if you head a corporate aviation department, hardly a day will go by without salesmen trying to upgrade you into the hottest new private jet or a used-airplane broker, dealer, or acquisition agent inquiring if any of your current fleet is for sale or might soon be.

"I think the whole world has my e-mail address," says John Ratcliff, Ford Motor Company's aviation director and chief pilot for North America, explaining that before he had even closed a deal on two new Gulfstream Vs, he was getting eight to nine solicitations a week to broker the Falcon 900 EXs they'd replace. "There's a great amount of speculation on the part of the brokers of the world, who are trying to ferret out where their next aircraft sale is coming from," says Ratcliff.



A Gulfstream V could whisk 19 of your salespeople from New York to Tokyo in 13 hours at Mach .885.

"It's the most gossipy business I've seen in my life. They have a hound dog atmosphere." And how do they sniff? "They watch the travel of the Gulfstream salesman and they make speculative guesses. If a Boeing salesman were to come to my office more than once in a month, somebody would know it, sure as we're standing here."

It's not uncommon for a good bit of money to fan these informational flames. Like celebrity spotters who tip off tabloid photographers, many a bit player in the corporate aviation industry has memorized the phone number of a broker who'll pay for a timely bit of information that leads to a sale. It could be a caterer who notes the name of a Fortune 500 company on a meal bound for a Global Express demo flight, or a line worker at a busy airport who sees a Gulfstream salesman with his arm around company X's chief pilot.

Such payments are known in the industry as birddog fees. Forty-year industry veteran Jim Welsch, owner

of Welsch Aviation in Huntington, New York, recalls that some years ago, when his brokerage office was at LaGuardia Airport, a limo driver swung by to inquire if he'd be interested in knowing the name of the company whose executives he'd just overheard discussing their need for a new jet. In this case, Welsch's interest ran to \$5,000; however, he says, "you can pay anywhere from 'phone money' to 50 percent of the commission."

The used jet market resembles nothing so much as a farflung international bazaar with no publicly visible central marketplace. Similarities with the real estate market pretty much begin and end with the idea that the seller hires a broker to get the best possible price for his valuable asset and the buyer, too, often has someone representing him in his search. Real estate agents and brokers are licensed; their commissions are typically set by local tradition. But brokers and dealers of private jets are unlicensed

and unregulated. They charge what they can. Percentages vary with the broker and the value of the airplane, even with the activity of the market. Smaller sales sometimes bring commissions as high as six percent. Even commissions of less than one percent on \$30 million private jets look like a very good year's work to most Americans. Outsiders can catch glimpses of this entrepreneurial arena by thumbing through publications like *Executive Controller* and *A/C Flyer*, which advertise airplanes for sale. But most ads do not include prices, only phone and fax numbers and e-mail addresses. Thus the dance begins.

Cutting in is not especially welcome. Whereas the sale prices of homes are public record and published in newspapers, the nitty gritty of the used jet business, such as asking prices and selling prices and commissions, remains all but hidden from view. Since 1952, when it began publishing quarterly, the *Aircraft Bluebook Price Digest* has

done for used aircraft, including private jets, what similar guides do for the automotive industry—only far more selectively. “We sell to dealers, brokers, and industry insiders such as financial institutions that make aircraft loans only,” says *Aircraft Bluebook* editor Paul Wyatt. “We have an obligation to our subscribers to keep the information confidential. The aircraft dealer doesn’t want the buyer to come in with the book under his arm.”

No one knows for sure, but estimates of the number of agents who buy or sell at least a jet or two each year range from 400 to perhaps twice as many. Industry veterans like Dan Dickinson, who began their careers spinning rotary phone dials and tracking leads on index cards, are fond of saying that “anyone with a roll of quarters can sell an airplane.” Nowadays, thanks to cellular phones, e-mail, answering machines, and Web sites, it’s possible for a corporate pilot like Bill Murphy to moonlight as president of Jet Consultants, Inc. of Jupiter, Florida. On top of flying 40 to 50 hours a month, Murphy sells a handful of airplanes a year. He occupies the lower portion of the used jet sales pyramid. Dickinson’s four to five dozen transactions a year puts him up top. But even the biggest players in this highly fragmented industry enjoy no more than a two or three percent market share each. Used jets remain that rare 21st century industry: a multibillion-dollar business without any dominant, Goliath-size players.

Most of the buyers and sellers of corporate aircraft are mom-and-pop companies, and many, like Wings Aviation International of Franklin Lakes, New Jersey, have a second generation aboard. At Wings, Joe Carfagna Sr., who sold Learjets in the ’60s, now works alongside his wife, Catherine, and sons Joe Jr., 30, and Craig, 28. “The competition can be fierce. We’re talking about a fixed amount of airplanes here,” says Joe Carfagna Jr., explaining that the market for corporate jets fluctuates constantly, due to both external and internal factors. “If

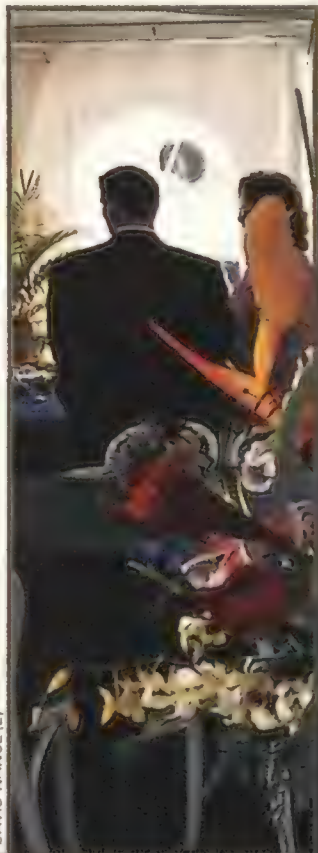
there’s some big announcement from Alan Greenspan or as soon as the economy takes a dip, airplane buying usually takes a dip as well. But what affects the market the most is the supply and demand in that particular type of aircraft. If you have as little as five percent of the fleet for sale, that’s low supply. Fifteen percent is high supply. Somewhere in the middle is usually where most of the markets are at.”

Aside from cashing in on a researcher’s well-timed cold call, the best way to grab an inside track on a good airplane is with long-term relationships. That way, stresses Dickinson, you can make an offer before the craft is listed for sale. “We have to be first in line when somebody decides to sell,” he says. “If you’re second in line, you lose. It’s pass/fail.”

That’s how General Aviation came by the Hawker 700, highlighted as a deal in progress on an easel-mounted flip chart in the office of Rick Teel,

who heads aircraft sales. One of the company’s overseas agents told them last fall of the impending availability of an airplane based in Jakarta they might want: manufactured in 1980, with only 5,000 hours, beautiful interior wood, and a warranty-like maintenance service plan worth about \$250,000.

Flipping back a couple sheets on the easel, Dickinson comes across an airplane the company didn’t buy. “We offered \$6.3 million for a Hawker,” he says. “Asking was 6.6. We never did get together. Most of them you don’t. Maybe one in 50.” He adds: “You can go buy an airplane and overpay. When we’re buying a plane we’re going to buy it right and then add value to it. Usually we buy an airplane that needs a lot of work.” He points to another line on the sheet. “Here’s our expenses on a Falcon 20F. Two hundred and fifty thousand dollars on a C-check [inspection], \$110,000 on paint and interior, \$80,000 in holding costs, \$25,000 on



DAVID NANCE (2)

Talking turkey in Bombardier’s hospitality tent (left). Seen from the window at Global Express are a Learjet 60 and Challenger 604 (bottom left). Got \$25 million? Fly this 604 home today (below).

PAUL BOWEN



Closing the Deal

So what happens to an aircraft during the buying or selling process? First of all, business jet brokers rarely take possession of the aircraft. To do so would mean storing it somewhere at their own expense. Besides, the seller wants to fly the plane as long as possible—especially if the seller is a charter company—so he typically operates it until there's a contract and the pre-buy inspection is arranged. "It's like juggling balls," Chicago area broker Dan Dickinson says. "We've got most of them in the air."

When inspection-time arrives, the airplane is flown at the buyer's expense to whatever maintenance facility is chosen. Most places tend to specialize in certain model aircraft, and manufacturers, of course, have their own facilities, which are often chosen for these pre-buy inspections. If the results of the inspection don't kill the deal, the sale then goes through and the airplane is flown to the buyer's airport of choice.

ferry [expenses to fly it from France], \$100,000 for engine containment rings. We paid \$1.9 million for the plane and by the time we were done we had \$2.6 million in it."

The Hawker 700 seemed a good airplane to inventory, so General Aviation arranged for the customary pre-purchase inspection. Since there was no place in Indonesia with the technical capacity, the jet was flown to Singapore. "One of our pilots flew the plane and we had an FAA-designated airworthiness examiner [a consultant flown in from Virginia who charged about \$1,000 a day] go through all the records for four days or so," explains Dickinson. "We hadn't even committed to buy the airplane yet."

As often happens, this due diligence uncovered several warts, a.k.a. points of negotiation. "There was a lot of documentation missing," says Dickinson. "For instance, we didn't have yellow tag releases for the [avionics], so we had to have all those radios re-certified." Dickinson explains that General Aviation agreed to buy the airplane if the seller put a couple hundred thousand dollars into an escrow account to cover the work deemed necessary to bring the airplane up to FAA specifications. General Aviation's pilot then flew the airplane to Garrett Aviation at Los Angeles International Airport, where the work was being done last spring, when a Midwest charter operator suggested to Dickinson: "What if I take you out of this plane right away?"

The charter operator had already bought a half-dozen airplanes from

Dickinson's company, among them two Hawker 700s—one from Malaysia, another from Russia. Dickinson could have held onto the airplane, finished the necessary work, marked it up in the neighborhood of six percent, and hoped it would sell quickly, as every day it remained unsold would cost him money. He settled for a smaller profit by selling the Hawker for \$4 million-plus, after essentially sharing his purchase price with the charter owner and agreeing on a fair markup. "It's a win/win," says Dickinson. "He gets a great deal on an airplane. He has instant equity. He can operate the plane and make money, and when he goes to sell it, he'll most likely make money on the plane." And, by helping the charter operator succeed, Dickinson earns first-in-line access when it comes time to sell the airplane. "If a charter operator overpays for a plane, he might make a half-million flying it but take a half-million loss when he goes to sell. But buying from me becomes a value-added situation for the customer because I pay attention to the resale value." This operator, in fact, agreed to buy the airplane on nothing more than Dickinson's good word. "About a third of the planes we sell are sight unseen with established customers like this one."

Such goodwill and trust are not universal industry-wide, as the contents of a long row of file cabinets in the General Aviation lunchroom sometimes attest. Here, the company saves files of transactions conducted before 1990 (since then the records have been



DAVID NANCE

kept on computers). The files cover every airplane it has bought or sold or simply inquired about. These records occasionally illuminate the industry's dark side. He recalls one instance in which an airplane his

company had maintained a file on turned up later with some discrepancies in its history: "We were buying the airplane and I said, 'Well, sir, with the damage history, this is what I can pay.' He said, 'What damage history?' I said, 'In 1985 this and this happened.' He had no record of it. Sometime in the last 20 years somebody had cut it out of the logbook."

"There are some pretty colorful characters out there with, shall we say, very entrepreneurial attitudes," says Tony Friend, president and CEO of Aircraft Shopper Online, whose open-to-all Web site (aso.com) charges not by the month but rather \$3.30 a day to encourage brokers to pull their ads as soon as an airplane is sold and thereby help combat the perennial problem of baiting a potential buyer with an unavailable airplane so that you can quickly switch the conversation to another airplane.

Longtime broker Von Rodman explains how the shells start swirling in this game. "A guy might run a phantom ad," says Rodman. "ABC company might call in and say they're interested in the plane. He'll say, 'It's been sold, but I've got another one,' and then he picks up the phone and calls somebody who's got a plane similar to that and registers this customer with that seller of the airplane, saying he's representing this buyer, when in many cases the buyer has no knowledge the guy has done this. Twenty years ago there was a lot of that. There's still some today, but it's not a major factor now."

Anyone desiring a window on the kinds of dubious practices that can tarnish jet sales need look no further than the 12-point code of ethics of the National Aircraft Resale Association, which takes dead aim at such Wild West practices as constructing deals to secretly pocket commissions from both the seller and the buyer, or greasing a sale with an under-the-table payment to a helpful employee of the purchasing company. One industry veteran tells of the pilot who wanted a Mercedes 280-SL quietly included in the "loose equipment" part of the deal. "Most agents would walk away," he says, as did he. "But some do not."

With the Internet triggering big changes in the business, an obvious question arises. Now that someone interested in purchasing a used jet can view color photographs, read about flight capabilities and history, and, easy as e-mail, arrange a demonstration flight—all from the comfort of his or her home or office—is there even a

need for brokers anymore?

Steve Dunne thinks perhaps not. Dunne, aircraft sales manager for Midwest Corporate Aviation Sales, Inc., a full-service charter operator in Wichita, Kansas, sold a Lear 24D within days of acquiring it by advertising on Aircraft Shopper Online. The airplane, which had a terrific pedigree—single ownership by an elite Fortune 500 company—caught the eye of the founder of a fast-rising software company. "He contacted me on a Monday about 11 a.m.," recalls Dunne. "We talked two or three times that day. I think he was getting advice from someone or he was very knowledgeable. He was asking all the pertinent questions, like cycle times. He called back at 11 that night and said, 'Steve, I've chartered a plane out of Van Nuys. I'll be there on the ramp at 7 a.m.' That day, Tuesday, he wired the money, bought the plane, and flew it back to California."

Clearly, Dunne adds, for the knowledgeable buyer, there's much less reason to go through the

brokers. The operative word, however, is "knowledgeable." "You can do a lot of things on your own," says Aircraft Shopper Online's Tony Friend. "You can defend yourself in a murder trial if you want to, but sometimes it's smart to pay someone who does it all the time." With multimillion-dollar airplanes, he emphasizes, "the repercussions of getting it wrong involve lots of money."

The best brokers add value to the transaction. By carefully matching a buyer's mission with an aircraft's capabilities, they accurately narrow the search. A good pilot may do this too. But most pilots are less in tune with industry trends, such as the arrivals of new jet models. Moreover, every bit as complex as the fluctuating markets and the engines and avionics of the airplanes themselves are the financial and tax nuances of buying and selling them. The best brokers provide guidance and can steer buyers to aviation tax experts. Buy a Gulfstream V in Florida and you can expect an immediate tax bill in the neighborhood of \$2 million, unless, say, you establish a leasing structure that might soften the tax bite to more like \$72,000 a year.

Every deal is different. "Every day is different. You don't know what's going to happen when you walk in," says Dickinson, pointing to one of the many attractions of his work. It's safe to make one prediction, however. Virtually every day will see him with a telephone pressed to his ear—whether it's his desk phone, with its extra long cord stretched so he can sit in his easy chair, taking notes on a legal pad, or his ever-present cellular phone—which even found its way into a recent family portrait.

Dickinson and his wife were posing with their two grown daughters. The photograph shows Nancy Dickinson with an arm around each daughter—and her husband using a familiar tactic to get everyone to smile. "Hey, this is more like our family," Dickinson said, pulling out his cellular phone as if to buy or sell an airplane. ➔

A Hawker 800XP that fetched \$4 million in 1995 might get \$6 million today.



PAUL BOWEN

BIG

My left hand rests on the throttle knob. Through the windshield I look out along the long nose of Steve Hinton's Curtiss-Wright P-40N Warhawk. The camouflage paint glistens in the light. Acquired by Hinton from a cloud-seeding company in the 1960s and beautifully restored by his Fighter Rebuilders in Chino, California, this Warhawk—now on display at the adjacent Planes of Fame Museum—is in top flying condition. BATTERY SWITCH ON... MIXTURE TO "IDLE CUT-OFF"... PROP PITCH FULL RPM... THROTTLE OPEN SLIGHTLY... PRIMER... MAGNETO SWITCH ON BOTH... CLEAR PROP...

It's been 56 years since I last

climbed out of the cockpit of a weary P-40F, its cowling streaked with oil and its olive drab surface battered and chipped. Yet as I sit here, I can remember the feel of the airplane around me in flight.

In early 1944, the Italian skies seemed to be alive with P-40s, and the drone of the 12-cylinder Merlin engine filled our heads from dawn to dusk. Yet scarcely three months after I flew my 97th and final combat mission, the Warhawk made its farewell sortie for the Army Air Corps in Europe and was replaced by the Republic P-47 Thunderbolt. It hung on with a couple of British and South African outfits in Europe and in squadrons in Alaska and the South Pacific.

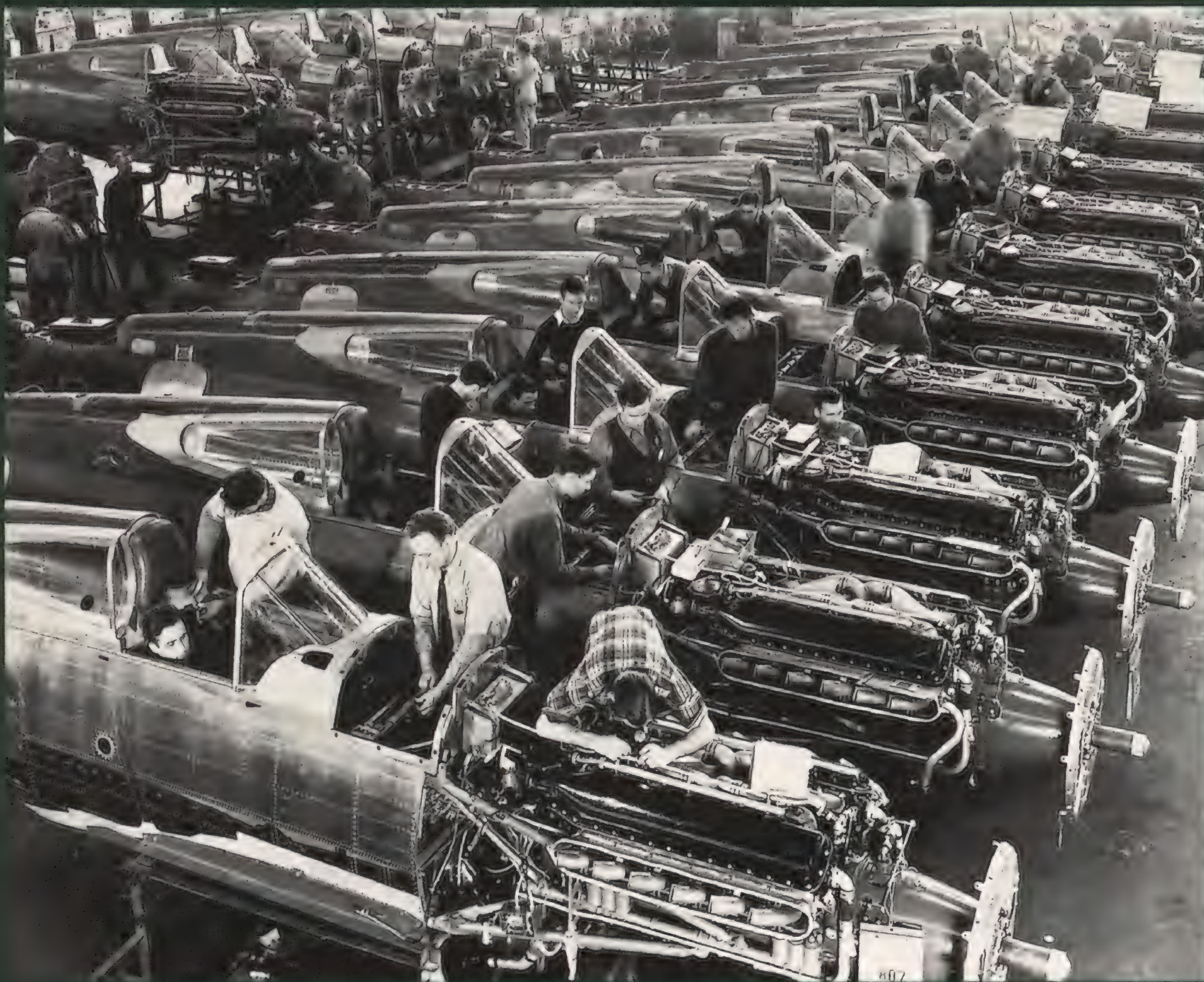
Warbird restorer Stephen Grey, flying a P-40M Warhawk owned by his Fighter Collection in Duxford, England, has helped lead the revival of this long-overlooked staple of Allied air power.



The P-40 Warhawk finally gets its due by Marshall Lumsden

FINISH

Illustration by [illegible]



From 1940 through 1944, Curtiss-Wright built 13,736 P-40s, charging Uncle Sam roughly \$54,000 each.

In October 1944, the last P-40N came off the assembly line at the Curtiss-Wright factory in Buffalo, New York.

In China it was rapidly being replaced by North American P-51 Mustangs and Lockheed P-38 Lightnings.

Back in the States it was relegated to training. In October 1944, after five years of production, the last P-40N came off the assembly line at the Curtiss-Wright factory in Buffalo, New York—number 13,736. Already considered obsolete, the P-40 quickly became a footnote to history.

Today there are fewer than 20 P-40s in the world still able to fly, compared to about 200 P-51s. Thanks to rebuilders like Steve Hinton (who is also president of the Planes of Fame Air Muse-

um), the number has grown since about 1970 and, miraculously, is still increasing. "In the past 15 years, ownership of P-40s has changed from people who didn't have any money to people who do," says Carl Scholl of Aero Traders, a warbird rebuilder in Chino, California. "Now they're viewed more as artifacts than as toys. That raises the level of investment. [Collectors are] willing to spend more money on them because they value them more."

I hear this with mixed feelings. Those who flew the P-40 during World War II can't help feeling secretly sentimental about it, but it was always a contro-

versial airplane. Created in 1939 when Curtiss grafted an inline 12-cylinder Allison engine (only a few models had the Merlins) onto a P-36 airframe, the P-40 was born of a wrongheaded strategy that limited pursuit aircraft to low-altitude, short-range missions. For the next five years, Curtiss-Wright kept tweaking the design, adding more armament, armor plating, and power in an effort to catch up with the growing demands of combat. The modifications never quite succeeded, though—the added power merely balanced out the armor and weapons additions. Performance remained sluggish.

Despite its shortcomings, it held the line until better fighters could be produced. American and Allied pilots racked up enviable records with the early models. The brief and glorious experience of the American Volunteer Group's Flying Tigers, who fought the Japanese in China between the summer of 1941 and July 1942, gave the P-40 a romantic aura that seems to be more seductive than ever today. (Younger generations can be forgiven if they believe shark teeth were part of the factory paint job on all P-40s; a few other squadrons used the teeth, but the Flying Tigers made them famous.) In spite of this, I never knew a P-40 pilot who wouldn't rather have been flying a P-51, P-47, or P-38.

Ken Scheiwe flew 162 combat missions in P-40s in North Africa and Italy. "You couldn't run away from an Me 109 and you sure as hell couldn't catch it," recalls Scheiwe, who retired to Fort Pierce, Florida, after a career in the FBI. "Your advantages were superior firepower, quick turning, and faster acceleration in a dive." The Warhawk's lack of speed left you with poor choices. Firewalling it, I discovered during my own missions, might get you an air-speed of up to 260 mph, but you ran the risk of blowing the engine a long way from home. Its lack of "bounce"—climbing quickly after a fast low pass—made it an easier target for ground fire on low-altitude missions, and experience taught you to make a getaway at treetop level.

But history feeds on romance, not facts. Currently, more than a dozen P-40 restoration projects are under way, despite the fact that it takes a minimum of \$1.5 million to restore a P-40 to flying condition. Hearing that, I remember wistfully when I was told "Remember, you're flying 50,000 dollars' worth of government property." But long before reaching today's astronomical levels, the value of the Warhawk sank far below its original price tag.

As the war ended, most of the P-40s, along with other warplanes, were beaten into plowshares, so to speak. A few surplus Warhawks survived as crop dusters or cloud seeders. In Canada, farmers paid \$50 or \$100 for them for the wheels, the gas in their tanks, and whatever metal parts they could put

to use, often stashing the remains in the corner of a barn or burying them in a field. In 1947, Seattle entrepreneur Fred Dyson made a deal with the Canadian government to buy 25 Royal Canadian Air Force P-40s stored at Patricia Bay Air Base on Vancouver Island. Dyson paid \$50 per airplane and barged them back to Boeing Field in Seattle. Some were eventually wrecked and abandoned. Some were mounted as advertising displays—at a gas station, an airport, a drive-in movie theater, and a used-car lot. However negligently they were treated, these old Warhawks eventually formed much of the foundation for the present-day fleet. The Warhawk I sat in at the Planes of Fame Museum in Chino is one of the survivors of Dyson's purchase.

Today's restoration movement probably owes more to John Paul, a manufacturer living near Boise, Idaho, than to any other individual. Paul acquired his first Warhawk, an E model, in 1966 while living in California. It underwent a four-year reconstruction, during which he discovered that parts weren't always conveniently available. He began picking some up from wrecked or disassembled aircraft around the United

States as well as in Canada and New Zealand, countries whose air forces had used P-40s during the war and in which there were also budding restoration movements.

Paul finished restoring his first Warhawk in 1970. Back then, his flying experience amounted to about 300 hours in a Fairchild PT-19. He remembers the first time he got the fighter running. "After a 200-horsepower Ranger, it was really exciting," he says. "You've got this great big Allison engine out there. Soon we got the brakes on it and we could run it around. We taxied it from one end of the Livermore [California] airport to the other. Hell, there would be 10 of us jump on the wings and we'd taxi it down to the terminal building, jump off and get a Coke, and then climb back on and ride it back to the hangar."

Paul taught himself to fly the P-40 with some advice from the late Frank Tallman, a motion picture stunt pilot (see "Our Brother Frank," *Above & Beyond*, p. 20). Today, Paul has more than 1,000 hours in his two P-40s, which he keeps at his Warhawk Museum in Boise. His expertise, his extensive collection of parts—"piles," he calls them—and

Though some P-40s were preserved after the war, most, like this upended and engineless lot at Walnut Ridge Army Air Base in Arkansas, were smelted.





In many aspects it was overbuilt, a fact I was keenly grateful for after taking a direct hit from a 20-mm German shell just behind the cockpit and being able to bring the airplane (and me) back.

his enthusiasm for the old Warhawk have inspired others who revere the P-40 as a fascinating part of U.S. aviation history. He believes he is responsible for helping to rebuild five airplanes. More importantly, Paul helped create a network of P-40 enthusiasts and rebuilders without which it would no longer be possible to restore one of these airplanes to flying condition. It is also a measure of the toughness of these old aircraft that they have been able to survive such tortured pasts. For example, Paul found one stripped and buried on a farm in Alberta, Canada. He dug it up, restored it, and sold it to an Australian collector.

One of the P-40Es that Dyson retrieved in 1947 ended up atop Tony Dire's gas station in Everett, Washington, where it remained for almost 20 years. In the late 1960s a buyer removed it to Chino, California, and war-

bird rebuilder Dave Tallichet managed to make it flyable again. It joined a flying circus, and then in 1985 was sold to a collector in Miami. In 1987, Dick Hansen, an electrical equipment manufacturer in Aurora, Illinois, purchased it. "I grew up during World War II, and all the magazines had pieces on P-40s," Hansen recalls. "I always dreamed about being a pursuit pilot, and the airplane I wanted most was a P-40. I was fortunate that John Paul still had some parts he was willing to let go." The restoration turned into a five-year job. Hansen fitted a P-40N Allison engine to it and painted it to look exactly like the airplane used by Flying Tiger commander Colonel Robert L. Scott (the author of *God Is My Co-Pilot*), with U.S. Army Air Corps and Chinese markings and, of course, the familiar shark's teeth. Hansen finished the restoration in 1992 and still flies the craft. "It's been

a very maintenance-free airplane," Hansen says. "The only thing we had to replace was the water pump."

Since there are virtually no whole aircraft available for rebuilding any longer, today's collector is faced with the choice of buying a fully restored airplane or starting with a heap of wreckage. The latter course involves a worldwide search for pieces from some unlikely sources. One engine cowl was discovered in use as a doghouse in a Georgia backyard, and a perfectly good cockpit canopy turned up in New Zealand serving as a greenhouse in somebody's garden. Surprisingly, Allison and Merlin V-12 engines are among the easiest items to find, and there are even people who specialize in rebuilding them.

Copies of original Curtiss-Wright blueprints are *de rigueur*, obtainable on microfiche from the National Air and

No P-40 in military service would have flown with this combination of British roundel, camouflage, and shark's teeth, but the paint scheme suited the Lone Star Flight Museum in Galveston, Texas, which sold this craft in 1997 (opposite).

Space Museum, along with a portfolio of assembly line photographs showing how the airplane was put together. There are about 70,000 parts in a P-40. The task is further complicated by the fact that there is more than one version of the airplane. Although the airplane has a kind of generic identity—the wings, main landing gear, empennage, and hydraulic systems remained much the same—Curtiss-Wright kept coming up with new models. Essentially there were seven basic versions with minor variations. Engines got more powerful, armament increased, cooling systems were redesigned (which changed the shapes of air intakes and chin cowlings), instrument panels were reshaped, and in some models the fuselage was lengthened.

In the process of rebuilding, restorers are learning how well the old P-40 was constructed. In many aspects it was overbuilt, a fact I was keenly grateful for after taking a hit from a 20-mm German shell just behind the cockpit and being able to bring the airplane (and myself) back. Almost every pilot I knew had a story of being saved by the ruggedness of the Warhawk. But in some cases its design flaws worked against it. Up until the very last model, the control surfaces were fabric covered, an absurd weakness in a combat fighter-bomber in World War II. Dave Gatling, who flew 190 P-40 missions in the Mediterranean theater, hit a German fuel truck on a strafing mission near Rome and inadvertently flew through the fireball of the secondary explosion. He barely missed hitting the ground, and was able to keep it in level flight only by holding full right stick and right rudder. The fabric on the ailerons had been burned by the heat and hung on the frames like a pair of baggy pants. Gatling is more inclined to credit his safe return to God than to Curtiss-Wright.

The early models, P-40Bs and -Cs known as Tomahawks, are the rarest



P-40 enthusiast Kent Lentz fits a skin stiffener to "Old 297."



A P-40B brought from Russia is now in the care of Curtiss Hawks.



Curtiss Hawks' Tom Wilson peers through holes salvagers left after removing the guns from a P-40K, which was recovered from Alaska.

and therefore most valuable. They are also the most historically significant: These models helped hold the line against the Axis, first in the hands of the British in the western African desert, then with the Russians, and finally with U.S. Air Corps pilots in China, Hawaii, and the Philippines. During the Battle for Luzon, Lieutenant Boyd "Buzz" Wagner became the first American World War II ace in an early-model P-40.

In 1993, the crashed remains of some early Russian Tomahawks were discovered in the Murmansk/Archangel area. Stephen Grey, owner of the Fighter Collection in Duxford, England, contracted to recover two of them. One was lifted out by helicopter, but the second, unknown to the salvagers, still carried a 500-pound bomb, which exploded, destroying the helicopter and killing its crew.

In 1994, Grey sent the surviving P-40C to Steve Hinton's Fighter Rebuilders for restoration. The airplane had been shot down by a Luftwaffe fighter, but aside from numerous bullet holes it

was in fairly good structural shape. In September 1998, Hinton, who in 1979 had set a world speed record of 499 mph for piston-engine airplanes, took the rebuilt P-40 for its first flight in 55 years. "The really neat thing about it," Hinton says, "was that it was preserved untouched. The fuselage was nice, just dinged up, the wing leading edges were smashed, but we got a lot of parts and a lot of help from different people, and we put a lot of hours in it." One person involved was John Paul, who was able to provide some missing parts. Shortly after its first flight, Grey sold the airplane to Paul Allen, the cofounder of Microsoft; it is now in his private collection in Seattle.

Meanwhile, the search for wrecked P-40s continues. Researchers pore over 55-year-old accident records, hoping to spot a recoverable airframe. Remote wreck locations are closely guarded secrets. It helps to know somebody like Dick Odgers, who runs an airplane repair and rebuilding service in Soldatna, Alaska. Odgers says he has al-



CHAD SLATTERY

A battered pilot's seat is one of the challenges faced by restorers like John Paul (opposite). Paul is known for his parts collection and his P-40 expertise.

To create the P-40, Curtiss engineers removed the radial engine on the P-36, attached an inline Allison, and then tweaked the design—mostly by changing the tail shape—to improve

handling. Additional improvements leading up to the P-40N included flush riveting to reduce drag and new trim tabs on the ailerons to reduce rolling during dives.



"Lope's Hope" is a P-40N that National Air and Space Museum deputy director Donald S. Lopez used to fly 96 missions in China.



Since there are virtually no whole aircraft available for rebuilding, collectors are faced with either buying a fully restored airplane or starting with a heap of wreckage. The latter course involves a worldwide search for pieces from some unlikely sources. One engine cowling was discovered in use as a doghouse in a Georgia backyard.

ways had a love affair with P-40s and was a big fan of John Wayne in the movie *Flying Tigers*. For 20 years, he has been hunting down P-40 wrecks in the Aleutians, where the foul flying conditions and remote island environment bedeviled fighter pilots during World War II. He has found and recovered a dozen crashed P-40s so far. "Some of the parts I've retrieved are used to make patterns for manufacturing new parts," says Odgers, who has his own P-40 project under way. "The top and bottom longerons are the toughest things to come up with, and they're the hardest to duplicate because they had too many angles. They went from half-round to about square and then flat right behind the pilot."

But for sheer persistence and passionate commitment, it's hard to beat

Kent Lentz. Lentz is president of the Curtiss-Wright Historical Association Project Tomahawk, Inc., a nonprofit, tax-exempt, educational corporation dedicated to honoring the early-model P-40B and -C Tomahawks. Lentz sits at the desk in his upstairs office in a hangar at Torrance Airport, California, surrounded by photographs, drawings, posters, old magazines, and books pertaining to his favorite aircraft. "World War II was the biggest deal ever, really," he says, "and if you become a historian and you really research everything, you'll find that the P-40 was one of the most significant American fighters built. It wasn't necessarily the best, but it was important because it was there when we needed it."

On the hangar floor below, the remains of a P-40B, serial number 41-13297,

are slowly coming back to life under the patient hands of volunteer craftsmen. This one isn't a Soviet airplane but a U.S. Army Air Corps Tomahawk—the only P-40, Lentz contends, that survived the attack on Wheeler Field in Hawaii on December 7, 1941. But on January 24, 1942, Lieutenant Kenneth Sprankle took it up on a training hop and spun it into the side of a mountain on Oahu. The log showed the airplane had only 56 hours of flying time. Rescuers chopped out the pilot's body with axes, and salvage crews removed what could be carried off. The rest of it remained there until 1989, when Lentz and his late partner, Mike Fortner, were able to raise enough money to bring what was left back to Torrance.

There weren't enough parts for a whole aircraft, but in the early 1990s



Steve Hinton attempts to outrun two Japanese Zero replicas during filming for Pearl Harbor, to be released next year.

two P-40Bs that had been lost since 1941 in the High Sierra in California were discovered. Lentz set out to recover what was left of them. One was 12,000 feet high on a steep mountain and had to be lifted out by helicopter. The other was at about 7,500 feet, not far from a heavily traveled mule trail. Lentz led the expedition. "I went up a week early and took about three lessons

on local riding," he recalls. "We went up with 14 mules and 12 horses and 19 volunteer members. One of the wing flaps was probably the biggest piece we could bring back."

Old 297 is coming back slowly, but Lentz, who spent most of his career as a machinist in the aerospace industry, is now working on it virtually alone while still trying to keep the project

going by raising funds from individuals and organizations keen on the P-40. "There are some people who are in this restoration industry because they kind of like the airplanes and they want to make some money," Lentz explains. "And then there are some people in it who absolutely love the airplanes and making money is secondary. That's the group I fall into. We pay for the privilege of doing it."

One aircraft that

will certainly be a privilege to own still rests in the silt bed of a lake in Kunming, China, under 20 feet of water. Recent sonar images show the aircraft to be fairly intact. It has been there since April 26, 1942, and when it is raised, as the Sino-American Aviation Heritage Foundation hopes to do late this year, it should have a white "68" on the side, along with 10 rising suns to indicate 10 kills and, of course, the shark's teeth on the engine cowling. It belonged to Chuck Older, at the time the leading Flying Tiger ace in China. But on that fateful day it was flown by one Lieutenant Blackburne, who cut it a bit fine while buzzing the lake. His body was recovered two days later, but number 68 has been there ever since. It is the only original Flying Tiger airplane in existence, so its recovery will be that much more significant.

Why does anyone expend so much effort and money to bring back an old airplane? Judy Pay, an Australian who is restoring a P-40F recovered from a small island in the New Hebrides where an American pilot crashed in late 1942, has a quick answer: "Because they want one of them, and it's the only way to get it." Still, there seems to be something more, something that goes beyond an appreciation of the aircraft's unique place in history. Rudy Frasca,

Tomahawks saw action even before the U.S. entered World War II: The Flying Tigers flew P-40s to help defend China against Japan.



whose company, Frasca International, manufactures flight simulators, has a collection of 40 flyable vintage airplanes at his airport in Champaign, Illinois. His P-40E, which he bought restored for \$126,000 in 1976, is one of his favorites. "People now flying the P-40 are changing their minds about them," he says. "Those are darned nice flying airplanes. I just feel good when I fly it. The aileron control is so sharp and crisp and you've got that long nose out there, and for me it's one of the nicest fighters to roll."

Ron Fagen, a Granite Falls, Minnesota pilot whose P-40 won the newly created Phoenix Award at the 1999 Oshkosh fly-in, also owns a P-51 Mustang, but he says: "I'd rather fly a P-40 than a Mustang any day."

But I can't help remembering the planes the way I knew them. In my memory they were battered and beaten up and pushed to their limits day after day, bouncing off short bumpy runways loaded down with armor plate,



CHAD SLATTERY (2)

Frasca International's Dale Rapp inspects Rudy Frasca's P-40E in the company's hangar (above) before the owner takes to the air (bottom).

ammo, bombs, and fuel, dinged by flak, repaired on the run by heroic crews working outdoors in all kinds of weather. They rolled quickly and turned well and they were stable and rugged, but often they were too poky for the game they were in. Still, as I climbed out of

the cockpit of Steve Hinton's P-40N and slid off the wing on one knee—the last time I had skipped off and had been wearing my parachute—I thought: How wonderful that they are back. The P-40 has long been written off, but nobody ever said it wasn't tough. —

"People now flying the P-40 are changing their minds about them. Those are darned nice flying airplanes. I just feel good when I fly it."



► SIGHTINGS ◀



In the early years of aviation, it seemed everyone wanted a piece of the action and a share of the glory, as evidenced by this selection of photographs from the Surrey, England-based Quadrant/Flight International Collection of aviation images. Back then, passengers took chances few would today, such as this eager group of four British daredevils (opposite)—weighing a total of 738 pounds, including the pilot—who were treated to a seven-mile flight through the countryside, never rising more than 80 feet above the ground. If there wasn't enough room for everyone on board, would-be passengers could watch from the ground or, in the case of the Seagull (right), from the shore. This early floatplane, shown by England's Blackwater River in 1913, drew a natty group of well-wishers.

As for this sporting attempt at human-powered flight (below right), the results are unknown. But judging by the flier's high angle of attack, presumably low airspeed, lack of vertical stabilization, and dangly legs, one can presume that, no matter how vigorously he flapped, the effort ended soon after the photograph was taken.



Just the Facts

Apollo 12: The NASA Mission Reports

Edited by Robert Godwin. Apogee Books, 1999. 248 pp., \$16.95 (paperback).

If you are a space geek tired of many an Earthbound scribe's attempt to wax poetic about a place he's never been, or fed up with the garden variety overviews of NASA's glory days found in most space histories, then *The NASA Mission Reports* series may light your candle.

The first of *Apollo 12*'s four chapters is a verbatim version of NASA's media kit. In the agency's best unadorned verbiage, it documents the upcoming Apollo 12 mission from crew training to post-flight quarantine and just about every other tidbit in between, including what's cooking. Reading the section on the crew menu, you can almost hear Walter Cronkite informing his viewers of the delicacies that await mission commander Pete Conrad on day four's lunch: "shrimp cocktail, ham & potatoes and chocolate pudding...and that's the way it is."

Cronkite never saw the contents of the book's second and third chapters. They were published expressly for NASA's senior management and detail both the



pre-flight summary and the post-flight mission review. Essentially, they are an insight into what the upper management at NASA needed to know.

While all the information provided has its place, the true highlight of *Apollo 12: The NASA Mission Reports* is the "Technical Crew Debriefing." Consisting of formerly classified information, the 106 pages of transcribed dialogue allows the reader to sit in as the Apollo 12 crew reflects on the good, the bad, and the hairy of their mission for the benefit of future lunar crews. It is a glimpse into both the techno-speak and the right stuff that astronauts are both renowned and notorious for. Describing the launch in which two electrical discharges almost killed the mission and crew, Pete Conrad laconically states: "The flight was extremely normal...for the first 36 seconds then after that got very interesting." Then there is command module pilot Dick Gordon's description of his first docking between the command module and lunar module: "I used the VERB 63 needles (the NOUN 17 needles came off during turnaround) and went to SCS control, ACCELERATION COMMAND in pitch, and pitched up at 1

deg/sec. It was extremely smooth.... When it pitched 180 degrees, the S-IVB was right smack in the middle of the COAS." The book's acronym index helps the reader sort through the astrospeak.

Those who find such space patter taxing can skim the mission press kit while loading the enclosed Windows-compatible CD ROM. In it they'll find NASA's official 1970 publicity movie about Apollo 12—what little television footage was sent from the surface before the TV camera malfunctioned—hundreds of photographs, and an exclusive interview with Apollo 12's Dick Gordon. It is recommended that you have a fairly fast computer with an 8X CD ROM drive, as slower drives may experience playback problems.

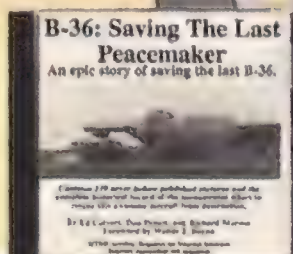
Other NASA Mission Reports chronicle the flights of *Friendship 7*, Gemini 6, and Apollo 8, 9, 10, 11, and 13, as well as NASA's unmanned missions to Mars. Apogee plans to publish a book on every manned NASA mission from Mercury through Skylab, and several of the more challenging shuttle flights. —D.C. Agle is a pilot and aerospace writer living in Playa del Rey, California.

CD

B-36: Saving the Last Peacemaker

by Ed Calvery, Don Pyeatt, and Richard Marmo. ProWeb Fort Worth (817) 534-0209, \$19.95.

The efforts to save a B-36 from the smelters. Contains many cockpit and detail shots for modellers.



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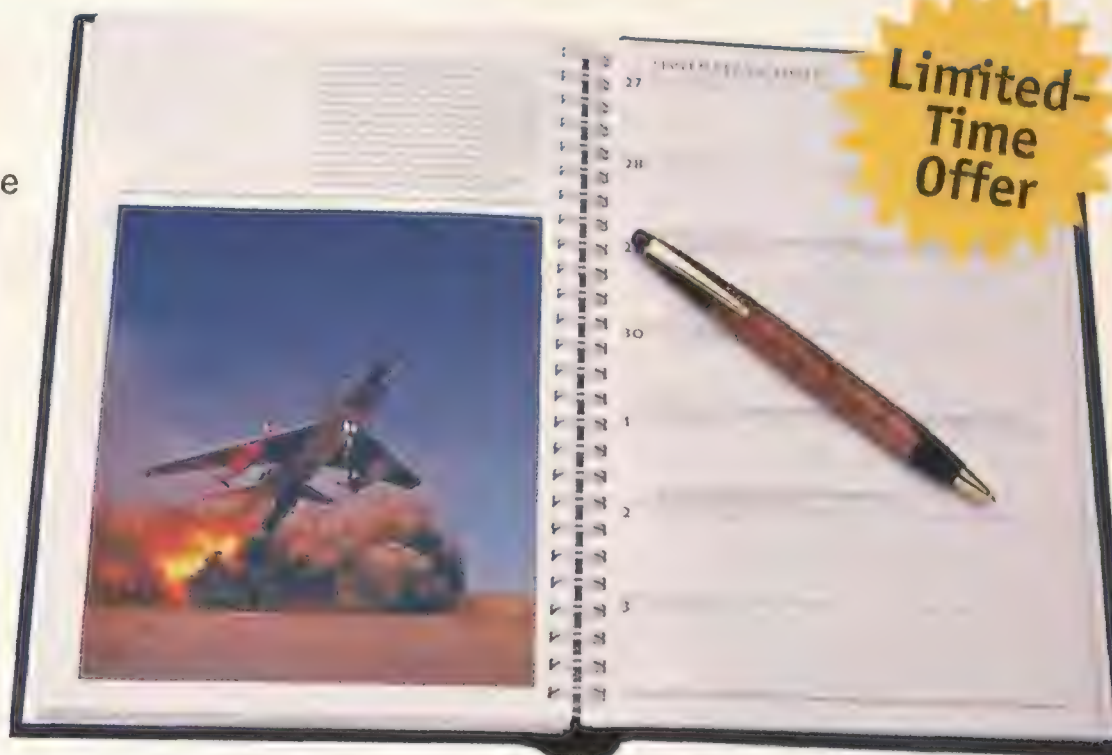
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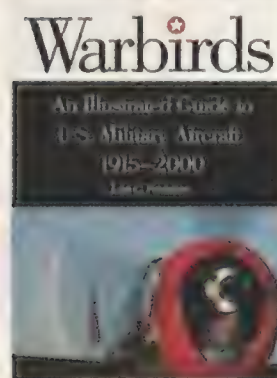
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Warbirds: An Illustrated Guide to U.S. Military Aircraft, 1915–2000

by John C. Fredriksen. ABC-CLIO, 1999. 377 pp., large format, b&w photos. \$75 (hardbound).

John Fredriksen has given us a portrait, specifications, and brief history for each of 327 U.S. warplanes. Is that every one? Well, I checked those known to me, and all are present and accounted for, including such obscurities as the CW-21 Demon, whose only brush with U.S. service was when three were acquired (and wrecked) in 1941 by the American Volunteer Group in China. And some famous airplanes, like Jack Northrop's Flying Wings, didn't make the

cut because they were never deployed. Between the extremes, you'll meet all your old favorites...then browse the intervening pages for new ones. Just now my eye was caught by the pretty Vought F7U



Cutlass, "a sparkling performer [that] was also prone to engine failure and inexplicable crashes," Fredriksen notes. He adds that 400 were built and that they killed 25 pilots.

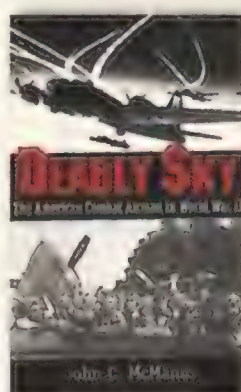
This is a splendid reference, made all the better by a lengthy bibliography pointing the way to detailed information. —Daniel Ford's favorite warbird is the Piper L-4 Grasshopper—top speed 87 mph, ceiling 9,500 feet, and range 250 miles, with 5,413 in service between 1942 and 1945.

Deadly Sky: The American Combat Airman in World War II

by John C. McManus. Presidio Press, 2000. 368 pp., \$32.95 (hardbound).

Despite the dramatic title, this is not just a book of action-packed war yarns. It is, rather, a thoughtful and well-constructed look at the lives of U.S. combat airmen during the war. McManus, a historian, takes the long view of his subject, always searching for the most representative stories of the time. In that mission he succeeds admirably.

For some readers, the routine of statement and proof may seem too academic or repetitive, especially in the opening chapters, which do not involve combat. These readers may want to skip to the middle of the book, where things get exciting. Keep in mind, though, that McManus has his reasons for being thorough, and wants the reader to gain a deeper understanding of combat airmen and the experience of war. His history is



roughly chronological, carrying the reader through the ups and downs of training, the mundane work of military life, the terror of combat, the intense joys of soldierly brotherhood, and the anguish of losing a

buddy to enemy fire.

McManus is determined to get the airman's point of view, but he is not a passive observer. Even when he highlights the shameful aspects of the war—the indignities suffered by the Tuskegee Airmen, for instance—he couches his disapproval in reminders that those were different times and that was a different culture. This kind of disclaimer is rare, though—McManus usually lets the veterans speak for themselves.

Especially moving are the words of the men who struggled to make sense of the horrors of war. They were not simply extensions of the war effort but fiercely independent men who thought seriously about what they were doing. One flier tells the story of shooting down an enemy pilot and watching him burn to death as he parachuted to Earth. Another, used to flying with his own crew, flew a different aircraft and watched as his friends went down.

The most frustrating aspect of the book is that the veterans who tell these stories, whose names often appear again and again and to whom the reader may become attached, are never introduced. We know their jobs but never their origins and rarely their fates. By its nature, though, the book was bound to feel incomplete. The storytellers of *Deadly Sky* repeatedly tell us that those who have not experienced war can never truly understand it. For those who want to try, though, this book is not a bad place to start.

—Daniel Weidinger is a journalism student at the University of Missouri–Columbia and a recent intern at Air & Space.

VIDEO

Destination Space

National Geographic video, 2000. \$19.98.

Space history from Sputnik to the International Space Station. Includes a supplementary program, "A View of Mars."

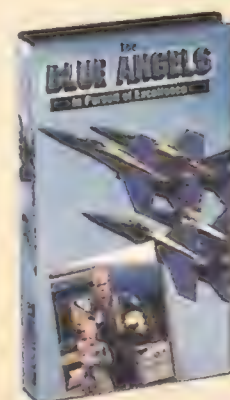


The Blue Angels

The Fighter Pilot & Me

Dreams Come True Productions (716) 232-3480).

Videos for kids featuring the U.S. Navy's Flight Demonstration Team (\$15.95) and a ride in an Air Force F-16 (\$12.95).



Red Planet

Warner Brothers. Release: November 3, 2000.

The once pristine blue, brown, and white dappled globe has turned dirty and gray. A voice from the bleakness explains: "It took us 100 years to go from the Industrial Revolution to putting a man in space. It took us only another 100 to poison and overpopulate the planet so seriously that if we didn't go out and find somewhere else to live, we were going to die out within two generations...."

So begins *Red Planet*, a film based not on Robert A. Heinlein's classic but on an original screenplay with a shopworn theme: Earth is dying and Mars has been chosen to be the suburban sanctuary.

It's 2050, and the Mars Terraforming Project had been bubbling along, on its way to creating Earth, the sequel. But suddenly the induced evolutionary process stopped.

Now, a team of astronauts—Robert

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★ **Lockheed P-38J** ★
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The Lockheed P-38J Lightning looks like it did on D-Day—with engine exhaust streaking its wings...five tank busting rockets under each wing...four machine guns and a cannon in its nose...and the pilot's nose art, "Mama's Boy," just outside the cockpit. 8 1/2" wingspan.

The great allied fighter planes captured in models so authentic, you'll see engine exhaust streaking on the wings and a pilot in each cockpit. Just \$29.95 each.



★ **North American** ★
P-51D Mustang

The North American P-51D Mustang is the legendary fighter that shot down more enemy aircraft than any other. Manned by "Bunnie," Rosco C. Brown, one of the famed Tuskegee Airmen, wearing his authentic flight gear. 6 1/4" wingspan.



★ **Chance-Vought** ★
F4U-1A Corsair

The Chance-Vought F4U-1A Corsair is considered the finest piston-engine fighter plane ever. Now the plane that knocked out 68 Japanese Zeros in its first action is captured in die-cast. 6 1/4" wingspan.



★ **Curtiss** ★
P-40E Warhawk

The Curtiss P-40E Warhawk is decorated with the emblem of the "Flying Tigers" who helped the Chinese fight the Japanese. It was the only modern American fighter plane in service at the time when the Japanese attacked Pearl Harbor. 6 1/4" wingspan.



★ **Grumman** ★
F6F-5 Hellcat

The Grumman F6F-5 Hellcat shot down an incredible 5,156 enemy aircraft, thus earning the moniker the "Ace Maker." Now captured with authentic U.S. Navy graphics and nose art. 7" wingspan.

When axis aggression threatened world peace, America and her allies responded—with the best equipment and the most courageous pilots. Now the wings that won the war can be yours forever in a collection crafted to a new standard of authenticity and value by Matchbox Collectibles.

This collection honors some of the greatest fighter planes ever, including the legendary Mustang and Hellcat. It captures the planes that played a pivotal role in major battles like D-Day. And it pays tribute to

heroes like Pappy Boyington in his Corsair Navy fighter...and Captain Brian Lane of the British Air Force who flew his Spitfire through flak-filled skies at the Battle of Britain.

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★ **Supermarine** ★
Mk1a Spitfire

The Supermarine Mk1a Spitfire was crucial in countering the German Luftwaffe with its Browning machine guns, Hispano cannon, wing-mounted rockets and massive bomb load. 6 1/4" wingspan.

Each die-cast plane comes with its own display stand.



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Gallagher, a mechanical systems engineer played by Val Kilmer, Kate Bowman, commander of the Mars-bound ship aptly named Ares (Carrie-Anne Moss), and other specialists and crew members played by Tom Sizemore, Benjamin Bratt, Simon Baker, and Terence Stamp—are commissioned to find out what went wrong, fix it, and save the human race.

There will be plenty of testosterone-driven action in this \$70 million movie, most of which was filmed at Martianesque locations in the deserts of Australia and Jordan. *Red Planet's* dark futuristic premise and stylized look (the production designer and costume designer, among others, hail from *The Matrix*) will have some viewers making a connection to the beloved *Blade Runner*. Others will view that as a stretch.

In any case, whether the movie will launch into movie history books is up to you.

—A.J.S. Rayl is a Malibu, California-based writer who covers science, technology, and pop culture.

Roundup: Flight Simulator Peripherals

Sidewinder Force Feedback 2 Joystick. Microsoft, (800) 426-9400, www.microsoft.com, \$109.95.

The Force Feedback 2 stick will showcase the same torso-twisting handle for easy in-flight rudder control that made the first stick a success a few years back. The new stick will, however, also incorporate a number of subtle improvements, such as offering Universal Serial Bus (USB) support and a re-designed 70-degree throttle lever that replaces the throttle wheel found on the

first generation of Sidewinder sticks. The eight-position hat switch has also been enlarged, making it much easier to use in conjunction with other buttons. Finally, Microsoft added an onboard power supply and updated the CPU, which now boasts a beefy 16-bit 25-MHz processor. The best part is that the *Sidewinder's* footprint has been reduced, somewhat, and the unit is quieter and more efficient than its forerunner—making it the likely stick of choice for most flight sim enthusiasts for several years to come.

X36 Flight Control System. Saitek Industries, (800) 452-4377, www.saitekusa.com, \$99.95.

Hands On Throttle And Stick (HOTAS) control systems have been around since the earliest days of computer gaming, although Saitek's new X36 flight controller currently offers the most bang for the buck.

To begin with, the new X36 control stick and throttle/rudder system offers USB support, so players can plug in and play with their dual-control device in the blink of an eye. The ergonomically designed control stick bristles with five



fire buttons, two eight-way hat switches, and a "pinky" shift function with LED indicator that are all neatly configured

around the control device. The stand-alone throttle/rudder control device, which is connected to the control stick via a single cable, features a movable throttle handle, a built-in rocker switch for rudder control, a multiple position toggle with LED indicators for changing modes, and a three-position auxiliary switch. Bottom line? With the unit's accompanying Saitek Gaming Extensions software, game setups are a breeze once you get the hang of it.

Sidewinder Game Voice with Headset. Microsoft, (800) 426-9400, www.microsoft.com, \$49.95.

Recognizing the growing popularity of real-time, voice-over-Internet communications, Microsoft set out to create a hardware-enabled protocol based upon its DirectPlay Voice technology. Enter the Sidewinder Game Voice system, a combination stereo

headset and desktop control unit designed to facilitate voice chat and voice commands over the Internet and Local Area Networks (LAN) during massive multi-player battles.

While software-based voice communication programs such as Roger Wilco and Battlefield Communicator have been on the market for a couple of years, they have their limitations. For one thing, the Game Voice system lets players record, send, and receive specific commands, such as "Break left" or "Clear my six," something the software-only programs can't duplicate.

Flight Sim Yoke USB. CH Products, (760) 598-2518, www.chproducts.com, \$149.95.

While joysticks are great for mock dogfights, they aren't the best way to handle general aviation aircraft. For that, you'll need a yoke.

As its name implies, the new twin-handle CH Products yoke offers USB support, so it will work with either a PC or a Macintosh computer. It also contains over 20 buttons and levers, including a mixture lever, separate throttle and propeller levers, a two-way flap switch, two-way rocker

switches, and four push buttons for auxiliary controls. Most importantly, the *Flight Sim Yoke* features an eight-position hat switch, which enables pilots to look around in virtually all directions.



PRO Pedals USB. CH Products, (760) 598-2518, www.chproducts.com, \$109.95.

If you do decide to go with a yoke, you'll probably want to pick up the all-new PRO Pedals USB, also available from CH Products. While torso-twisting joysticks are good at providing some rudder control, the pedals' sliding motion is still the best way of handling an aircraft in the yaw axis. The pedals also have heel-toe pivot capability, so players can stop or slow their taxiing aircraft.

The system is rugged and exceptionally stable, even under heavy usage, and it includes a three-year manufacturer warranty. The pedals are wide enough to accommodate even the largest of feet, but the unit is somewhat clumsy and hard to store below a desk. But this is a small price to pay for one of the most durable pieces of hardware you can add to your flight sim collection.



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REVIEWS & PREVIEWS

PV230 DSK Super-Sized Display System.
Panorama Technologies, (818) 504-0714,
www.panoramtech.com, \$9,995.

And then there's the PV230 DSK Super-Sized Display System, undoubtedly one of the most impressive toys you can add to your homebound cockpit. The sleek monitor features a flat panel wrap-around screen that contains three segmented image display areas. When taken collectively, the oversized screen



provides users with over 2.4 mega-pixels of viewable real estate. The mammoth 55-pound display unit

and 12-pound power supply module are supported by a fully articulated swing arm, which can be adjusted in multiple directions and configured for just about any purpose.

Price? Well, as the saying goes, if you have to ask...

BattleChair. Interactive Seating, (805) 650-9956, www.battlechair.com, \$199.00.

The BattleChair, which features a digital surround-sound audio system, also has rolling caster wheels, a tilt-and-swivel base, and twin armrests that can accommodate a HOTAS arrangement such as the X36. Most importantly, the seat has a 100-watt eight-inch subwoofer built into the back of the chair, which is connected to a wave chamber located within the hollowed-out seat back. Seven speakers are situated throughout the chair, including two fanning out from either side of the headrest. Trailing wires are connected from the back of the chair to an ordinary stereo amplifier hooked up to a PC.

Essentially, audio is pumped from the computer into the speaker's diaphragm, which compresses the air so that it generates vibrations in the tuned, resonant panels. The idea here is that players not only hear the game they're playing but feel it as well, thanks to the sensation caused by the low-frequency omni-directional sounds pulsating throughout the chair. While the seat can't be adjusted for larger individuals, it does turn the average simulator into a rip-roaring three-dimensional experience. —Marc Dultz is a freelance computer simulation reviewer living in Bayside, New York.

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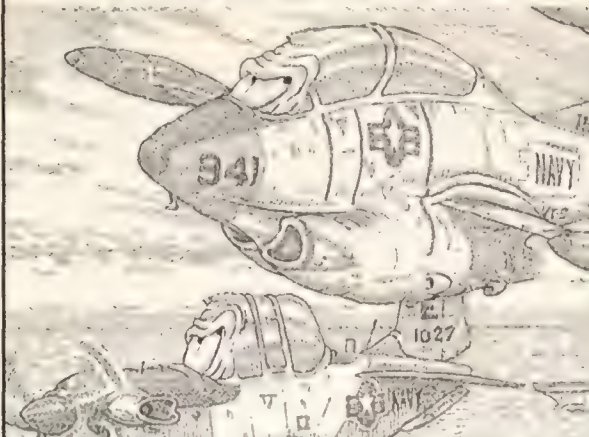
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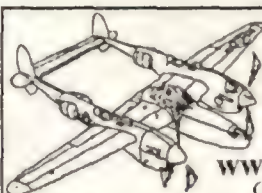
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October 7

Fall AirFair Fly-In Pancake Breakfast. EAA Chapter 690. Sport Aviation Complex at Briscoe Field, Lawrenceville, GA, (770) 394-5466.

October 7 & 8

Air Show 2000. Planes of Fame Museum, Chino Airport, Chino, CA, (909) 597-3722.

FINA-Confederate Air Force AIRSHO 2000. Midland International Airport, Midland, TX, (915) 563-1000.

International Airshow 2000. Alliance Airport, Fort Worth, TX, (817) 551-1967.

Wings & Wheels 2000. Airshow and classic car show. Quitman Mitchell Field, Bessemer, AL, (205) 939-1275.

October 7–9

Great War Fly-In & Concourse. Creve Coeur Airport, St. Louis, MO, (314) 955-6178.

October 10 & 11

U.S. Naval Institute Warfare Exposition and Symposium. Pavilion Convention Center, Virginia Beach, VA, (410) 268-6110 or www.usni.org.

October 11–13

Reunion: 27th Air Transport Group, World War II. Menger Hotel, San Antonio, TX, (828) 891-5422.

October 11–15

Reunion: 325th Fighter Group, World War II. Embassy Suites Hotel, Corapolis, PA, (616) 731-2421.

October 14

Old Fashioned Grass Field Fly-In and Pig-Picking. EAA Chapter 970, Ridgeway, VA, (540) 956-2159.

October 14 & 15

EAA Chapter 186 Fall Fly-In and Pancake Breakfast. Winchester Regional Airport, VA, (703) 780-6329.

October 25–28

University Aviation Association Education Conference. Mesa Pavilion Hilton, Phoenix, AZ, (334) 844-2434.

October 30–November 5

Reunion: 6147th Tactical Group "Mosquitos," Fifth Air Force, Korean War. Doubletree Hotel, Tucson, AZ, (520) 881-4200.

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The space shuttle on Pad 39-A.



CAMERON DAVIDSON

FORECAST

In the Wings...

Vietnam Memoir: The Christmas Bombing

In this issue, we brought you the experiences of North Vietnamese MiG pilots during the Vietnam War. In the next, we visit North Vietnamese surface-to-air missile crews during a 1972 B-52 bombing campaign.

Also...

What You Don't See in the National Air and Space Museum

The hard cases: dirty, beat up, but wondrous aircraft that look just as they did when they were brought 50 years ago to the Museum's Paul Garber Preservation, Restoration and Storage Facility.



GEOFFREY CLIFFORD

The North Vietnamese army's 77th Missile Battalion conducts tactical exercises in preparation for what became Linebacker II.

CREDITS

Our Brother Frank. Prudy Tallman Wood, a La Jolla, California-based freelance writer, has written for *Travel and Leisure*, *The Los Angeles Times*, and *Sailing*.

The Lunar Module's Evil Twin. Joshua Stoff is the curator of the Cradle of Aviation Museum in Garden City, New York. He has written 13 books on aviation and space history.

Tales From the Space Shuttle. Andrew Chaikin is editor of *Space Illustrated* and author of *A Man on the Moon: The Voyages of the Apollo Astronauts* (Penguin Books, 1998).

100 Missions. This is illustrator Harry Whitver's third poster for *Air & Space/Smithsonian*.

Go For Launch! Nan K. Chase is a freelance writer based in western North Carolina. She compiles the monthly Travel News column for *Hemispheres*, the inflight magazine of United Airlines.

Space Shuttle Impersonator. Debbie Gary says her 29 years of low-level airshow flying paled in comparison to the thrill of her two flights in the Shuttle Training Aircraft with astronauts Mike Bloomfield and Jim Halsell.

Nguyen Van Bay and the Aces From the North. Ralph Wetterhahn has written numerous articles about the Vietnam War for *Air & Space* and other magazines. He's currently working on a book about the war's final campaign in Southeast Asia, to be published next spring by Carroll & Graf.

Jet Set. John Grossmann is a freelance writer who lives in Mountain Lakes, New Jersey.

Big Finish. Marshall Lumsden is a writer and retired magazine editor living in Malibu, California. From October 1942 until April 1944, when he was very young and unwise, he flew P-40Fs with the 324th Fighter Group in North Africa and Italy, surviving 97 combat missions, he says, by the grace of God.

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Road Trip

In June 1995, Ronald Clem set the straight-line distance record for radio-controlled model aircraft: 426.82 miles. He snatched it from Maynard Hill, who was left with three records: duration (33 hours, 39 minutes), speed on a closed circuit (150.25 mph), and altitude (26,922 feet), among other radio-control milestones. "It wasn't so much breaking his record as it was setting my own," says Clem. But he held the title for only six weeks before Hill snatched it back with a flight of 459 straight-line miles. And Clem really wanted that record again.

For his second attempt, he designed a new airplane, one that fit the Fédération Aéronautique Internationale parameters for Class F3A, Radio-Controlled Model, Piston Motor Airplane. It had to weigh under 11 pounds, with a wing loading factor of not more than 24.57 ounces per square foot and an engine displacing less than 61 cubic inches. His secret to long flight: "It's not getting a gas tank big enough, it's getting an engine that uses little enough gas." After conquering a few mechanical problems, his *Avenger*, a work in plywood, balsa, and composites with a stock Irvine diesel engine, was ready to set a record.

At dawn on June 14, 1998, Clem and his six-member crew launched from eight miles north of Shasta Lake in northern California, trailing *Avenger* in a convertible and a pickup as the speedy model headed south some 500 feet above Interstate 5—"The straightest road we could get," says Clem.

Just 175 miles down the highway, however, the airplane developed engine trouble and started losing altitude. Outside of Sacramento, with *Avenger* barely hanging in the air at treetop level, Clem prepared to crash it into the shoulder.

He kept jogging the throttle, though, and hit what he calls "a magic setting." Later he would learn that the carburetor had worked loose, but for now all that mattered was the airplane would climb again. They weren't out of the woods yet, though: Clem had to run a gauntlet of underpasses that masked the signal. "You're out of sight for three or four seconds, and with loss of radio signal and wind gusts, it might not be where you expect it to be," he says. Yet somehow it always was.

The odd entourage wound down California's San Joaquin Valley, through the 4,100-foot Sierra Madres range—with *Avenger* clearing a bridge at the mountains' peaks by a mere 20 feet—and then ran

into headwinds at the landing site, the Apollo 11 Model Flying Field in Van Nuys. In 11 hours, 41 minutes, the team had flown (and driven) 563 miles and set a new straight-line distance record: 517 miles.

Clem says he wasn't really trying to get even with Hill. And as for their "friendly rivalry," it's still not over, Clem reports. "I wanted to make it harder for him to break the record. But he's got the capability of doing it." In fact, Hill tried that same year and lost his airplane—literally—in a rain squall just 30 miles short of his goal. Clem now has his sights on a 1,000-mile attempt—Colorado to Indianapolis. But Hill is making a quantum leap, testing a model he's designed to fly 2,000 miles across the Atlantic, Newfoundland to Ireland.

Moments & Milestones is produced in association with the National Aeronautic Association. For information, visit the NAA Web site at www.naa-usa.org or call (703) 527-0226.



LOGBOOK

Awards

The NAA's **Elder Statesman** award was established in 1954 to honor Americans who have made significant contributions to aeronautics. Last September at the NAA Fall Awards ceremony in Washington, D.C., the award for 2000 was presented to:

- Gladys Dawson Buroker, former parachutist, wing walker, flight instructor, and airport operator
- Jack Eggspuehler, aviation safety educator
- Lois Feigenbaum, longtime promoter of women in aviation
- Buck Hilbert, founding member of the Experimental Aircraft Association
- John Roach, the first African American chief of a Federal Aviation Administration Air Carrier District Office, and a member of the Tuskegee Airmen
- Merv Strickler, senior authority on U.S. aviation education
- Kenneth Wofford, recipient of the Distinguished Flying Cross and member of the Tuskegee Airmen

Competitions

France and Russia dominated the **20th World Aerobatics Championship** held in Muret, France, last August, as did the French CAP 232 and Russia's Sukhoi 31, the aircraft flown by more than a third of the 77 competitors. France's Eric Vazeille placed first in a CAP 232, Russia's Mikhail Mamistov took second place in a Sukhoi 31, and France's Eddy Dussau, in a CAP 232, came in third.

Russia, France, and Italy took first, second, and third place, respectively, in the **8th World Parachuting Championship in Canopy Formation** last July in Immola, Finland. The United States and the Netherlands tied for fourth place. Participants were scored on the amount of time they required to build a formation, the number of formations built within an allotted time, and the number of "rotations"—a change in position within a formation—that a four-place team accomplished before landing.

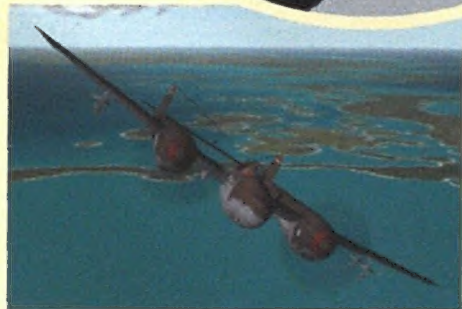
FEEL LIKE

a kid again.



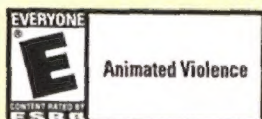
A **KID**, PILOTING A *Hellcat*
OVER THE PACIFIC, TRYING TO WIN
A **WORLD WAR.**

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